The FOUNDRY

Volume 57
Number 10

Published
Semimonthly

CLEVELAND, OHIO, MAY 15, 1929

Castings Allow Mechanization of Brick Manufacture

IN KEEPING with industrial trends toward continuous operation and the mechanical handling of materials, several plants specializing in the manufacture of clay and silica refractory brick recently have installed newly designed equipment. In the manufacture of the brick, the clay received from the pit is ground and otherwise treated before it is mixed with water in the proper portion. That mixture is screened and

Castings Are Used in the Construction of Machinery Which Pushes Bricks Through the Kiln

then pressed into the size of brick desired. The brick thus formed are loaded on cars operating on a track near the large presses, and the cars then are pushed through a tunnel type kiln by an electrically operated pusher. Each kiln used for burning the brick is equipped with six automatic stokers on a side and the temperatures are checked carefully with recording pyrometers. The kiln, which is approximately 500 feet long, is divided into three sections, consisting of the preheating, burning and cooling zones. After the cars of brick pass through the kiln, the burned product is hauled to the storage bins, electric locomotives being used for the purpose. As in the case of practically all industries, the foundry is assisting in the mechanization of manufacturing operations, for much of the equipment utilized in the production of brick by the mechanical processes is constructed of castings.

Find Where Castings Can Be Sold

CONTENTS

FEATURE ARTICLES

Page

Small Foundry Adopts Conveying Equipment—By Edwin Bremer 408
Develops Rapid Method for Determining Clay in Foundry Sands—By H. L. Campbell 412
Melting Iron in the Cupola—Part XVIII—By J. E. Hurst 414
In Defense of the Foundry Chemist—By W. H. Spencer 418
Blast Furnace Operation Affects Quality of Pig Iron and Castings—Part III—By A. L. Boegehold 421
Makes Taxi Stand Sign of Steel Castings 425
Mechanical Equipment Triples Production of French Foundry—By Vincent Delport 431
Molds Large Castings in Small Foundry—By J. H. Eastham 434
Research To Govern Specifications for Cast Iron Pipe 435
To Present Series on Steel Foundry Practice 436
Bill Studies Mysteries of Core Oil—By Pat Dwyer 437
Introduction of Oil-fired Furnaces Made Changes in Brass Melting—By Edward L. Wolff and R. C. Jeter 440

REGULAR DEPARTMENTS

Questions and Answers on Foundry Practice 426
Problems in Nonferrous Founding — By Charles Vickers 430
Readers Comment 442
What Others Are Thinking 443
The Shakeout 444
Trade Trends in Tabloid 445
Comings and Goings of Foundrymen 446
What the Foundries Are Doing 449
New Trade Publications 450

PUBLISHED BY THE PENTON PUBLISHING CO., CLEVELAND, O.
BRANCH OFFICES

CHICAGO ..... 1147 Peoples Gas Bldg.
CINCINNATI ..... 209 Edwards Bldg.
NEW YORK ..... 2203-2206 No. 220 Broadway
PITTSBURGH ..... 2148-49 Oliver Bldg.
SAN FRANCISCO ..... 24 California Street
WASHINGTON, D. C. ..... 1663 Pennsylvania Avenue
LONDON, ENGLAND ..... 416-417 Caxton House, Westminster, S. W. 1
BIRMINGHAM, ENGLAND ..... 14 New Street
PARIS, FRANCE ..... No. 9 Rue de Londres
BERLIN, GERMANY ..... Wilhelmstrasse 114, Berlin S. W. 48

Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico ..... $3.00 a year
Canada ..... $4.00 a year
Great Britain and other Foreign Countries ..... £1:0:0 a year
Single Copies ..... 25 cents

Copies published three months or more previous to date of current issue, 50 cents each.

Member, Audit Bureau of Circulations, Associated Business Papers Inc., National Publishers' Association

The A. B. P. is a nonprofit organization whose members have pledged themselves to a working code of practice in which the interests of the men of American industry, trade and professions are placed first—a code demanding unbiased editorial pages, classified and verified subscribers, and honest advertising of dependable products

Copyright 1929 by the Penton Publishing Co.

Small Foundry Adopts *Conveying Equipment*

WHEN proprietors of small foundries the world over read of various labor-saving devices and materials transporting machinery employed in the large production shops, they shake their heads and say: "That may be all right for a big foundry, but it cannot be applied to my shop." On the face of it, this statement seems to be a self-proved fact. However, the work of certain small foundries creates a question regarding the correctness of the statement.

Years ago when machinery just began to replace handwork in numerous industries, many people believed that machines never could attain the accuracy and speed of handwork performed by craftsmen trained by years of experience. After it was shown that machines could do the work as well and better than men—and produce more than several men, a great hue and cry was raised that machinery would throw so many men out of work that the great mass of the laboring class would be faced by starvation. This fallacy has been disproved, and it is admitted that without machinery, industry would not be as far advanced as it is today. So many things now are done by machines, even in the household, that people would be lost without their assistance. If industry had not advanced, our present standard of living, comforts and well-being would lag far behind the present state.

When molding machines first were developed, many foundrymen could not see their value. These plant owners believed, as did their forefathers, that machines could not perform the work as well as skilled men. Another feature that militated against employment of molding machines was the great first cost when compared with labor costs of the time. However, when it was found that the increase in production soon paid for the investment, and allowed skilled foundrymen to be placed on jobs where their training was invaluable, more and more molding machines were employed. Now practically every foundry, no matter how small, has machines in use.

While all the labor-saving devices and materials transporting machinery used in the large production shops hardly can be applied to the

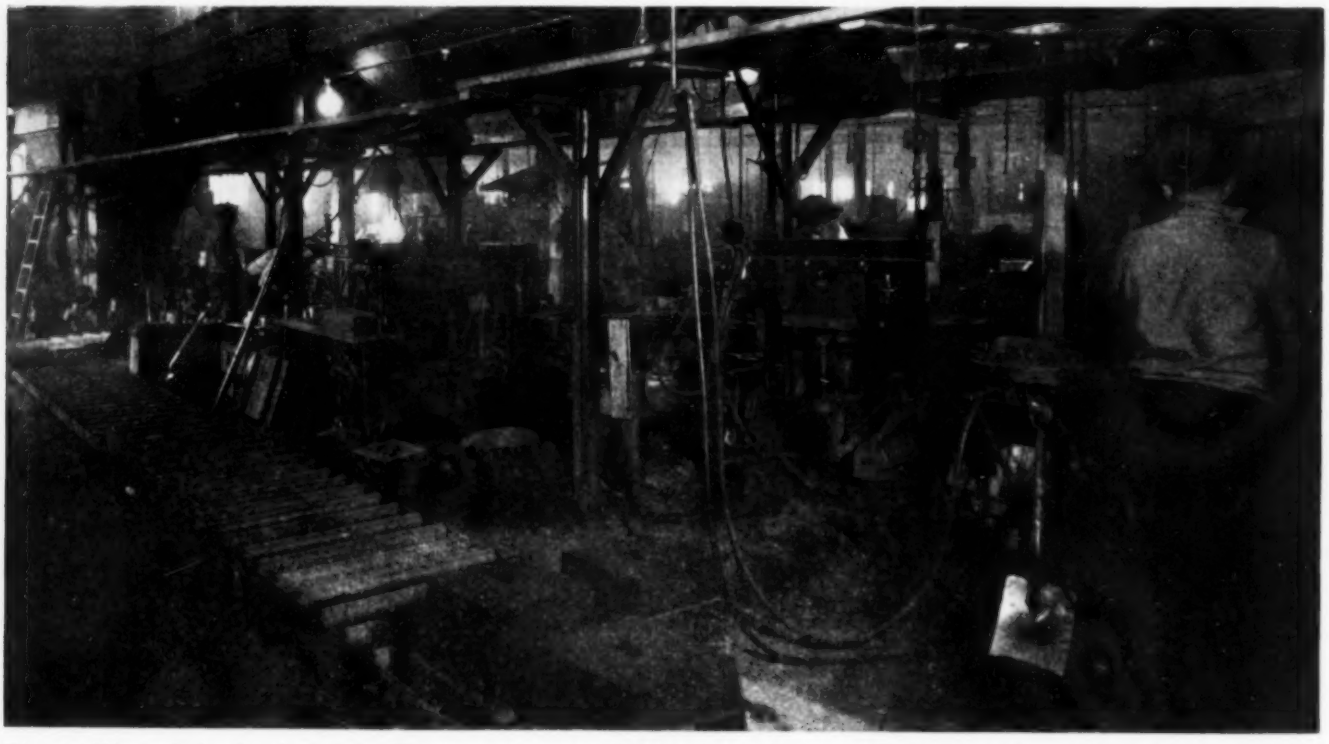


Fig. 1—View of the Sand Storage Hoppers Above the Molding Machines, and the Gravity Roller Conveyor Which Transports the Molds to the Shakeout

By

Edwin Bremer

Fig. 3—Rocking-Type, Indirect-Arc, Electric Furnace Supplies Hot Metal. The Charge Consists of Borings, Scrap and Pig Iron

small foundry, the trend points to the adoption of many of the principles involved. Too many foundrymen, reading of or seeing these new installations, fail to visualize the application of the equipment on a scale small enough to fit their own production methods. Foundrymen see only huge conveying systems with a myriad of rollers, belts, and chains for transporting molds from the molder to the pouring station, to the shakeout, and for returning the empty flasks to the molder. They see long conveying belts and numerous sand mixing machines for reconditioning and carrying sand from the shakeout back to the molder—and long lines of overhead hoppers which hold sand in readyness for the molders' use. However, it is one matter to see large installations and another to visualize them reduced to their essential parts and applied to a small foundry. While the main parts of a production line such as mentioned previously, briefly may be said to consist of a conveying system for molds and molten metal, a sand conditioning device with belts to convey the sand, and overhead

Fig. 2—Steel Plates Drawn by an Endless Chain Carry the Molds Along Light Steel Tracks. Pouring Is Done at the Opposite End of the System

Fig. 4—Molds Are Poured Along the Side Nearest the Electric Furnace

storage hoppers, it is not complicated. That this apparatus can be applied on a small scale is verified apmly by the accompanying illustration.

Some time ago E. A. Hobart, Hobart Bros. Co., Troy, O., decided to build a foundry to make the castings needed by the company. The firm manufactures a line of constant-potential generators and motor-generators for charging storage batteries, test benches with electrical equipment for testing automobile starting, lighting and ignition systems, stationary and portable air compressors and hydraulic car washers for garages, electric grinders and buffers, paint and lacquer spraying outfits, and arc welding machines. Gray iron and some nonferrous castings are used in the construction of the apparatus.

Since the company was not familiar with the various problems entering into the production of castings, it decided to begin on a small scale. To that end, a brass foundry employing two men was established. The shop was small because the requirement for nonferrous castings was light. An electric furnace of the indirect-arc, rocking-type, manufactured by the Detroit Electric Furnace Co., Detroit, was installed for melting brass and bronze and a gas-fired crucible type furnace was built to melt aluminum. Operation of the nonferrous foundry proved successful and thoughts then were turned to making gray iron castings.

However, before embarking upon any construction program, all features and problems of gray iron castings production were considered carefully from all angles. One point that had to be kept in mind was that at no time would production be extremely large. However, Mr. Hobart was familiar with modern conveying systems and realized their advantages, since a large number of conveyors are employed in the assembly lines in other parts of Hobart Bros. Co. plant. Basing his opinion upon his own experience with labor-saving devices and realizing that the modern production foundry also is employing all possible means of relieving drudgery of labor and increasing production, he concluded that most of the ideas of the large shop could be incorporated on a much smaller scale for the production contemplated. Therefore the foundry was designed to include a mold transportation system, overhead hoppers for storage of molding sand, a sand reconditioning system, and a monorail to carry the molten metal to the molds.

Overhead sand storage hoppers, shown in Fig. 1, are constructed from heavy steel plates with six lever-operated gate openings beneath to accommodate that number of molding machines. However, at present only four of the gates are used. The four openings allow sand to be dropped into flasks placed on a jolt-rollover molding machine supplied by the Arcade Mfg. Co., Freeport, Ill., and two jolt roll-over and one jolt squeezer molding machines built by the Tabor Mfg. Co., Philadelphia. The first mentioned jolt roll-over molding machine is equipped with two platens which contain the patterns for the cope and drag so that both parts of the mold are made at one operation. Flasks used for the molds were supplied by the Sterling Wheelbarrow Co., Milwaukee; Diamond Flask & Clamp Co., Richmond, Ind.; Hines Mfg. Co., Cleveland, and the American Foundry Equipment Co., Mishawaka, Ind.

The first mold conveying system installed is the roller type shown at the left in Fig. 1. This system operates successfully and still is in use. Later a different type of mold conveying system was built. As may be seen in Figs. 2 and 4, that device consists of a continuous double track along which bottom plates containing the molds slide. The mold conveying system is 8 feet wide and 60 feet long. The plates, which are steel, are equipped with sockets on the under side. The sockets fit over vertical pins fastened to an endless chain which travels in the center of the two

Fig. 5—Cores Are Baked in a Thermostatically-Controlled, Gas-Fired Oven

tracks. The chain is guided and supported on the long straight-away sections of the device by two angle irons extending the full length of the sections. The angle irons are mounted to form a continuous slot.

Each end of the mold transporting machine is arranged in a semicircle. Large sprocket wheels at either end engage the chain and support it at these places. Motive power is supplied at one end by a small motor whose motion is transmitted through a reducing gear to the large sprocket. Molds are poured along one side at a point near the electric furnace supplying the molten metal. Double shank ladles are used to carry the metal from the furnace to the mold, and these are placed in a pouring device manufactured by the Arcade Mfg. Co., Freeport, Ill. This device may be seen clearly in Fig. 4.

Since the pouring operation is performed near the shakeout, the molds are not shaken out upon reaching that point, but make a complete circuit of the system. As the mold reaches the shakeout for the second time, it is pulled off the steel bottom plate and allowed to drop on a shaking screen. The drop dislodges the sand and casting from the flask which is placed upon an empty board and returned to the molder. The rapid jarring action of the screen soon removes most of the sand from the casting. After being taken from the screen, the casting is placed in a wheelbarrow. When a load of castings is obtained it is removed to another part of the shop where any cores are removed. The castings then are sent to the cleaning department for chipping, grinding, sandblasting and other operations.

Sand from the shaking screen drops through a hole in the floor into a sand mixing machine made by the Blystone Mfg. Co., Cambridge Springs, Pa. The sand remains in the mixer for about five minutes after enough water is added to give the sand the proper moisture content. After mixing the sand is dropped into the buckets of a vertical elevator and carried from the basement to a storage hopper the bottom of which is situated approximately 4 feet above the floor of the foundry. From this storage hopper the sand is allowed to fall into a sand separator and blender supplied by the Royer Foundry & Machine Co., Wilkes-Barre, Pa. The aerated and blended sand is thrown from the machine upon a conveyor or belt mounted approximately at an agle of 45 degrees. This belt elevates the sand to and along the tops of the sand storage bins. Hand adjusted deflectors at each bin permit filling any desired bin or bins as the case may be.

Cores for the various castings are made in one corner of the foundry. A view of this department is shown in Fig. 5. Cores are made either by hand or on machines supplied by the International Molding Machine Co., Chicago, and by the Tabor Mfg. Co., Philadelphia. Coreboxes used on the machines are made of an aluminum alloy as may be seen in the left foreground in Fig. 5. The large cores, such as made in a corebox of the type shown in the illustration, are made in halves, baked and then pasted together. Sand for the cores is mixed in a sand mixing machine supplied by the Blystone Mfg. Co., Cambridge Springs, Pa. Cores are baked in a drawer type core oven manufactured by the Foundry Equipment Co., Cleveland. The oven is gas-fired and the temperature is controlled automatically by a thermostatic regulator.

As stated previously, the foundry first was established for the founding of nonferrous metals. For that purpose an electric furnace of the indirect-arc, rocking-type was installed. The furnace has a capacity of 500 pounds. Excellent results were obtained with that furnace, and later when the firm decided to enter the gray iron field, another furnace of the same type was selected for melting the metal. Considerable experimental work was necessary before all the details of furnace operation were synchronized and arranged to make the furnace a regular production unit. One difficulty encountered was the short life of the lining. While the regular lining served well for nonferrous melting, the high temperatures and corrosive action of the slags soon cut the lining to a point where it was unsafe. This difficulty was overcome by employing a rammed, monolithic lining composed of a patching material supplied by the furnace manufacturer. Since the Hobart Bros. Co. has considerable cast iron borings resulting from the various machining operations on its castings, a problem was encountered in disposing of the borings. However, by using the electric melting unit in the gray iron foundry, no difficulty was found in using the borings as the major portion of the charge for the electric furnace.

(*Concluded on Page* 417)

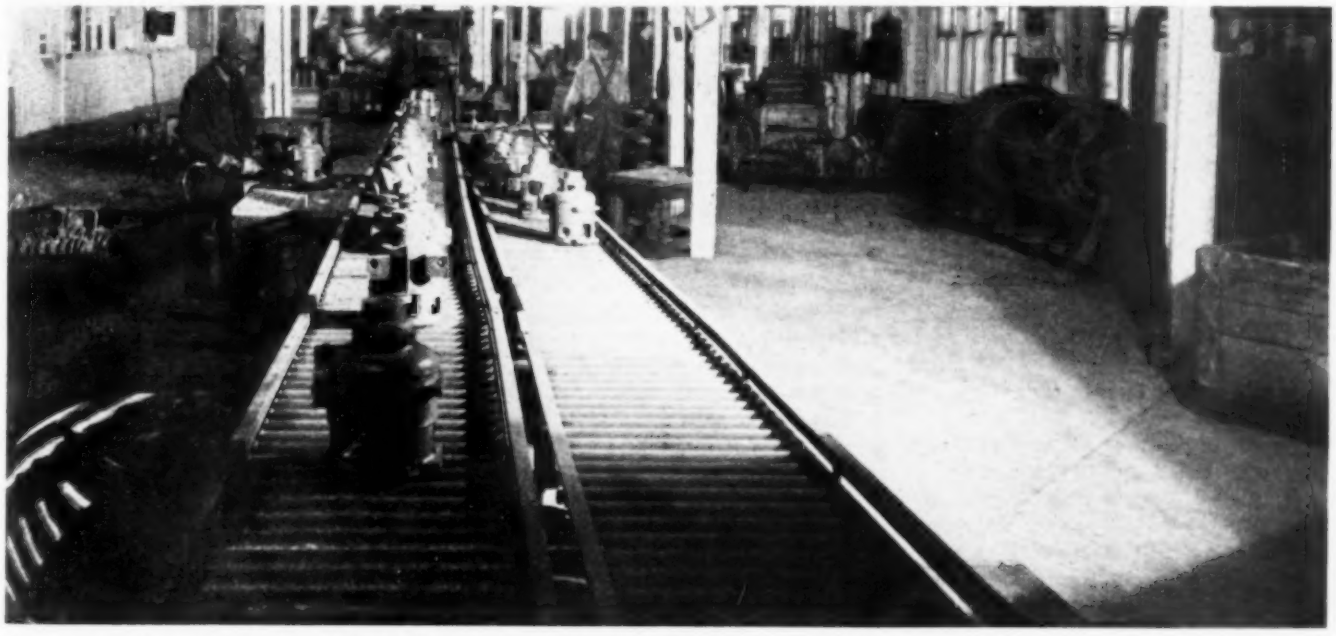


Fig. 6—Castings Pass Down the Roller Conveyor to the Grinders and Chippers, and Thence to the Spraying Booth

Develops Rapid Method

for Determining

Clay in Foundry Sands

By H. L. Campbell

ONE of the important determinations used in foundry sand-control practice is the measurement of the clay content of foundry sands. The material which is designated as clay consists of those particles which remain in suspension in water and may be washed from the sand. Under some conditions, this material has relatively little bonding effect. The fine silt or burned clay in used molding sand may collect in sufficient quantity to interfere seriously with the permeability of the sand.

In the evaluation of new molding sands, the clay content generally is determined to insure the correct application of definite types of sands. The American Foundrymen's association standard grading method classifies sands according to the clay content. The following classification has been established:

Class	Clay Content Per Cent
A	0 to 0.5
B	0.5 to 2.0
C	2.0 to 5.0
D	5.0 to 10.0
E	10.0 to 15.0
F	15.0 to 20.0
G	20.0 to 30.0
H	30.0 to 45.0
I	45.0 to 60.0
J	60.0 to 100.0

A method for the separation of clay from sand grains has been proposed by the committee on sand testing of the American Foundrymen's association. This method consists of placing fifty grams of dry molding sand in a 1-quart preserving jar, adding 475 cubic centimeters of water, with 25 cubic centimeters of 1 per cent sodium hydroxide solution, and then shaking the mixture for a period of 60 minutes. Following the agitation period, water is added to the jar until a height of 6 inches is obtained. The jar then is allowed to stand for 10 minutes, after which the water is siphoned off to within 1 inch of the bottom of the receptacle. More water is added, filling the receptacle, and at the end of 10 minutes siphoned off. Again water is added and after standing for 5 minutes, is siphoned off. The process of standing and siphoning is repeated until the water in the jar remains clear at the end of a 5-minute period. By this means, the clay substance is removed from the grains of sand.

This method for determining clay in molding sand, which is now a tentative standard, requires a large amount of time and much manipulation. An attempt has been made to develop a method by means of which the clay could be separated from foundry sands in a shorter time than is necessary by the procedure which just has been described.

In most new molding sands and in molding sands which have been used for some time, the clay adheres tenaciously to the sand grains. A grinding action is necessary to separate the clay from the sand. It has been found that the clay may be removed from the sand grains more readily by agitating the sand in a hot, alkaline solution. The length of time required for washing the sand may be reduced by providing a continuous flow of water to carry away the clay in suspension as soon as it is removed from the sand grains.

Fig. 1 shows the apparatus which is in use for separating clay from foundry sands. A steel frame is mounted on a wooden base so that it may be tilted and clamped in any position. A small motor and speed reducer are attached to the steel frame. On the slow motion shaft of the speed reducer, a cast-aluminum clamp is bolted rigidly. In this clamp a 2000 cubic centimeter pyrex glass flask is fastened so that it may be rotated about its central axis. The flask serves to hold the sample of sand and water during the grinding and washing period. Water for washing the sand is conducted to the inside of the flask by means of a glass tube. The wash water passes from the large pyrex glass flask through a glass funnel to a 500 cubic centimeter side-outlet flask which is called the sand trap. Any particles of sand which accidentally are carried from the washing flask are caught in the sand trap. An opening is provided in the steel frame for heating the flask over a gas burner.

The apparatus shown diagrammatically in Fig. 2 for washing the clay from molding sands may be assem-

Simplifies Procedure

CLASSIFICATION of sands by the tentative method of the American Foundrymen's association necessitates the determination of clay content. A suggested method of agitating the sand with water, allowing it to settle and then siphoning off the water and clay, requires considerable time. The new method described in the article reduces the time required for the operation and eliminates much handling of apparatus. H. L. Campbell, the author, is associate professor of metallurgical engineering, University of Michigan, Ann Arbor, Mich., and has done considerable work on cores and sands. He has written numerous papers on this work and along metallurgical lines. Mr. Campbell is a member of the committee on molding sand research of the American Foundrymen's association.

bled without difficulty in any laboratory. Most of the parts are listed in chemical supply catalogs. It would be necessary to prepare the wooden base, the steel frame, and the clamp for holding the washing flask.

One hundred grams of dry sand and 50 cubic centimeters of a 1 per cent sodium hydroxide solution are put into the 2000 cubic centimeter washing flask and the flask is then clamped to the apparatus. Water is supplied to the flask through the glass tube which extends to the far end of the flask. The side outlet on the sand trap is connected by rubber tubing to the wash-water waste. The steel frame is secured parallel to the base. After sufficient water is added to raise the level of the alkaline solution to the neck of the flask, the flask is rotated at a speed of 50 revolutions per minute while being heated over a gas flame. The grinding action is continued for about 5 minutes and the motor is stopped. After the sand has settled in the flask, the solution is washed out by a stream of water which is supplied at the rate of 400 cubic centimeters per minute. The flask again is rotated and the washing is continued until the wash water in the sand trap remains clear.

At the end of the washing period, the contents of the washing flask and the sand trap are transferred to a filter paper in a 9-centimeter buechner funnel, drained by means of suction, and then dried on a large watch glass, at a temperature of 105 degrees Cent. The dried sand is brushed from the filter paper and weighed. Difference between the final weight of the dry sand and the original weight of the sample of sand, expressed in grams, is the percentage of clay or finely divided material contained in the sand.

Separation of clay from some types of sands may be accomplished readily without the use of an alkaline solution or the application of heat. In such cases, grinding and washing may be started simultaneously and continued only until the wash water becomes clear. The alkali is added to the sand to defloculate the clay from the grains. It throws the clay into colloidal suspension and this facilitates it being washed from the flask.

Grinding action which is obtained by rolling the sand grains on one another tends to separate the coating of clay from the sand grains, within a relatively short time. The possibility of heating the mixture during the period of agitation will assist greatly in separating the clay from some types of sands. Relatively little manual operation is required in making a clay determination.

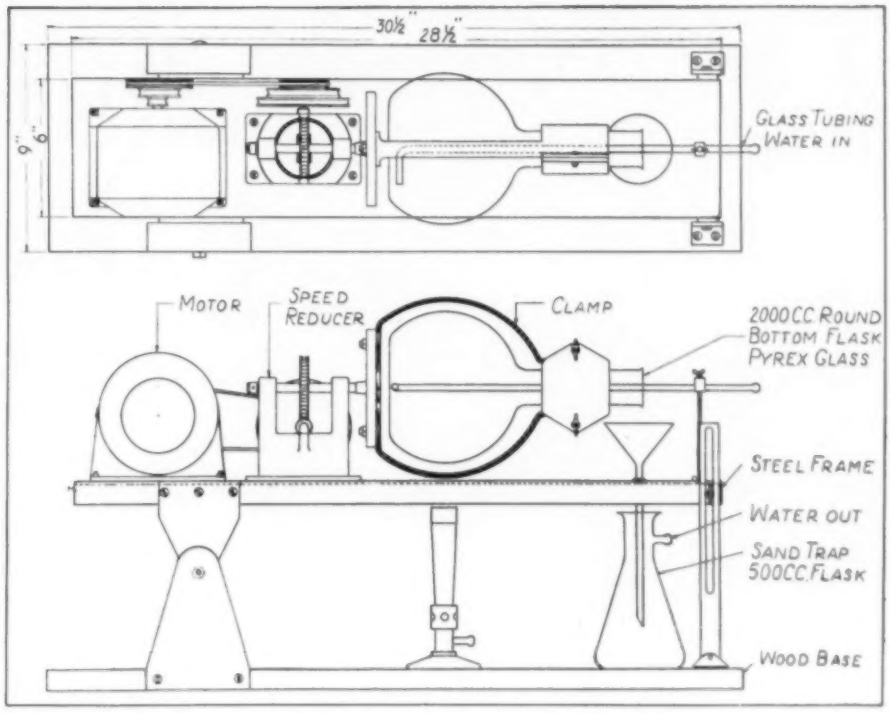


FIG. 2—DRAWING SHOWING THE DETAILS OF THE APPARATUS IN PLAN AND ELEVATION

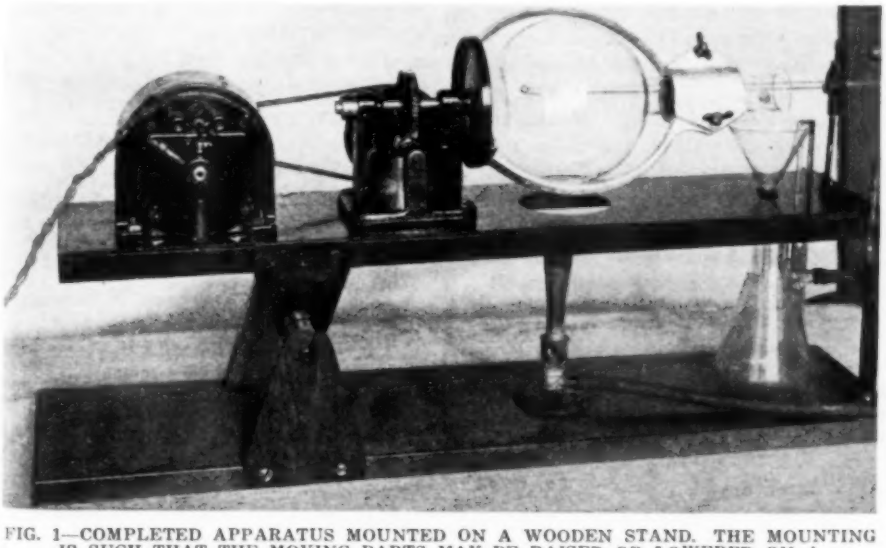


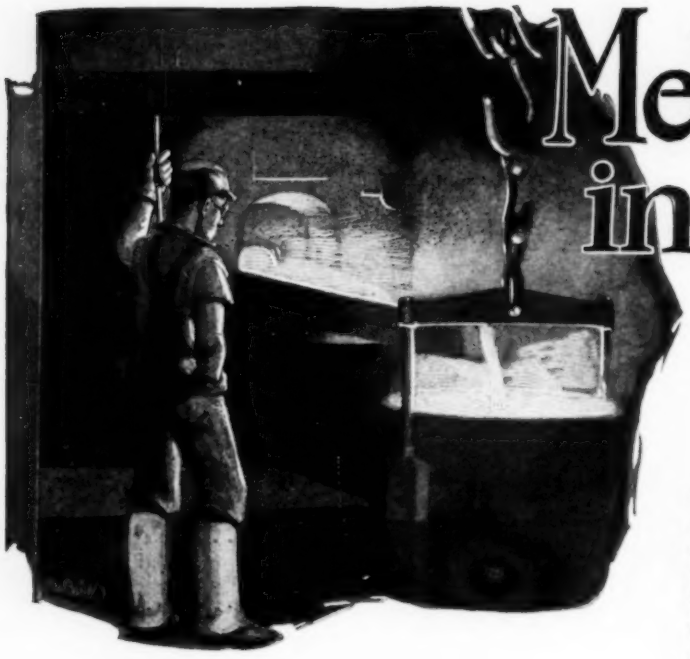
FIG. 1—COMPLETED APPARATUS MOUNTED ON A WOODEN STAND. THE MOUNTING IS SUCH THAT THE MOVING PARTS MAY BE RAISED OR LOWERED ON A HORIZONTAL AXIS

Book Review

Techniches Auskunftsbuch, by Hubert Joly, cloth, 1506 pages, 4½ x 7 inches, published by Joly Auskunftsbuch-Verlag, Kleinwittenberg, a. E., Germany.

German engineers, constructors, designers, foundrymen, and others interested in various types of engineering materials and equipment will be interested in the new edition of this monumental work by Joly which gives technical information, the price and the sources of technical products and materials. All apparatus and materials are listed alphabetically which assists in locating the desired information easily, and similar to the ordinary dictionary, a heading at the top of each page gives the first and last article described on the page. The book contains references to almost 3000 of the largest and foremost firms in Germany. An appendix of 31 pages at the back of the volume contains some useful tables such as tables of areas of circles; squares and cubes; trigonometric and logarithmic functions; postal, telegram and telephone rates, and many others.

The technical publicity department, Union Carbide Co. and associated companies, has moved from the Carbide and Carbon building, 30 East Forty-second street, New York, to the Bartholomew building, 205 East Forty-second street, New York.



Melting Iron in the Cupola

By J.E.Hurst

Part XVIII

ALL metallurgical operations involve the use of heat supplied in furnaces of various types designed to withstand high temperatures, and to conserve the heat from waste due to losses apart from the desired reactions. This material must be sufficiently inert to prevent the introduction of any undesirable constituent in the final product.

From earliest times plastic and more or less siliceous clays have been used for this purpose. Earliest shaft furnaces used for smelting were constructed almost entirely from plastic clays. These furnaces possessed in varying degrees the desired properties of heat insulation and neutrality to the smelting reactions, insofar as they concerned the introduction of impurities into the final metal. With the development in size and dimensions of shaft furnaces, these plastic linings gradually were superseded by built up linings. In the early days of iron smelting, blast furnace and cupola linings were constructed almost entirely of dressed stonework. Use of stonework lining for foundry cupolas is within the memory of many foundrymen still living and several stone lined cupolas have been in use in Great Britain practically up to 1914.

Probably the square construction adopted in early cupolas was determined largely by this use of dressed stonework, involving, as it did, considerably less labor than cylindrical construction. According to Overman, the coarsest sandstones were best. Red sandstones and millstone grits underlying coal measures also were found to give good results. Gornal sandstones of Staffordshire were favored for this purpose in Great Britain.

The lining of the modern foundry cupola is constructed almost universally of fireclay bricks although there is a reversion to the old type of lining, certain plastic clays, under the more modern title of monolithic linings. This feature will be considered at a later stage.

Select Refractories

SEVERAL species of refractory clay pressed into rectangular and special shapes have displaced the sand stone lining that formerly enclosed the interior of all cupolas. In a few isolated instances cupola men still insist on the use of a special stone lining, but the almost universal practice is to use brick. On account of intermittent operation, the brick lining of a cupola is subjected to more severe service than falls to the lot of the average furnace lining. The problem of spalling from alternate expansion and contraction always is present in addition to the usual problems of wear and tear and slag erosion. Many advantages are claimed for special tap hole blocks made either from brick material or from a plumbago mixture somewhat similar to that employed in crucibles.

Fireclay bricks or firebricks are made from siliceous fireclays found in various districts scattered all over the world. Basis of all clays is the so-called kaolin or china clay, found mixed with water, hydrated iron oxides, quartz and organic matter, to form variously colored plastic clays. In its purest form kaolin, a white powder, usually amorphous, is practically pure hydrated aluminum silicate containing silica (SiO_2) 46.40 per cent, alumina (Al_2O_3) 39.7 per cent, combined water 13.90 per cent.

Ordinary fireclays vary considerably in composition and almost always contain silica in excess of that present in pure kaolin. Typical analyses of British fireclays from the Stourbridge district are given in Table XXIV. These analyses represent clay in the dried condition, and the item "Loss when calcined over 109 degrees Cent." represents the amount of combined water and organic matter in the original clay. In the three typical analyses of firebrick given in Table XXV, this item is conspicuous by its absence, and thus clearly demonstrates the principal reason of firing or burning the brick to expel the whole of the combined water and organic matter in the original clay. After the firing process the brick presents a dense hard body, possessing considerable mechanical strength. Usually it is nearly white or pale buff in color, depending upon the amount of iron oxide present in the clay.

Refractory bricks employed in the construction of metallurgical furnaces should possess the following properties:

(a) High melting point and softening point under load.
(b) High resistance to spalling or disintegration under sudden changes of temperature.
(c) Low thermal conductivity.
(d) High resistance to erosion and corrosion under the particular conditions of operation.
(e) Minimum change in shape and volume under heat influence.

Simultaneous occurence of the opti-

mum of all these properties in any one refractory probably is unattainable. Fireclays possess these properties combined in the most useful proportions and for this reason are the most important refractory materials available.

Melting points of unused fireclay brick range from 1480 degrees to 1730 degrees Cent. Melting points and also softening temperatures of various commercial refractory materials under a load of 2500 pounds per square inch follow:

Brick	Range of Melting Points Degrees Cent.	Range of Softening Temperatures Degrees Cent.
Fireclay	1480-1730	1340-1480
Silica	1710-1720	1620-1675
Magnesite	1542-1710	1425-1565
Bauxite	1480-1595	1345-1480

Melting points and softening points of fireclay bricks rise with increasing percentages of clay and are reduced by increasing percentages of impurities, including iron oxide, lime and alkalies. Addition of 0.50 per cent iron oxide above that usually present, lowers the softening temperature 55 to 78 degrees Cent. About 0.10 per cent lime lowers this temperature 40 degrees Cent. Fine grained firebricks melt and soften at higher temperatures than coarsely grained material. Reduction in softening temperatures under load as illustrated is a factor of great importance in furnace construction. Use of badly shaped bricks often results in local concentration of the load, with a resulting local reduction in the softening point. This ultimately influences premature disintegration of the whole furnace lining which is the cause of much grief to the foundryman and leads to increased cost of production.

Liability of bricks to spall has received considerable attention during recent years. Tendency to spall or to disintegrate under temperature changes is a peculiar feature. In a brick of any given size, it is related to the mechanical strength, thermal conductivity, and coefficient of expansion. These properties in their turn are influenced by the composition, density and structure of the brick. The higher the degree of porosity, within limits, the greater the resistance to spalling. The limiting feature of course is reduction of mechanical strength with increase in porosity. It has been stated that fireclay bricks with grains of 3 millimeters diameter are 3 times as resistant to sudden temperature changes as bricks with grains below 0.8 millimeters diameter.

Composition of the material and thermal conditions during the firing operation exert the greatest influence on the spalling tendency of firebricks. Constitutional changes during the firing, determine the character of the constituents in the final brick. These in turn determine extent and character of volume changes which occur when the brick subsequently is heated in the furnace. Recent research with the microscope has disclosed some of the causes of these changes.

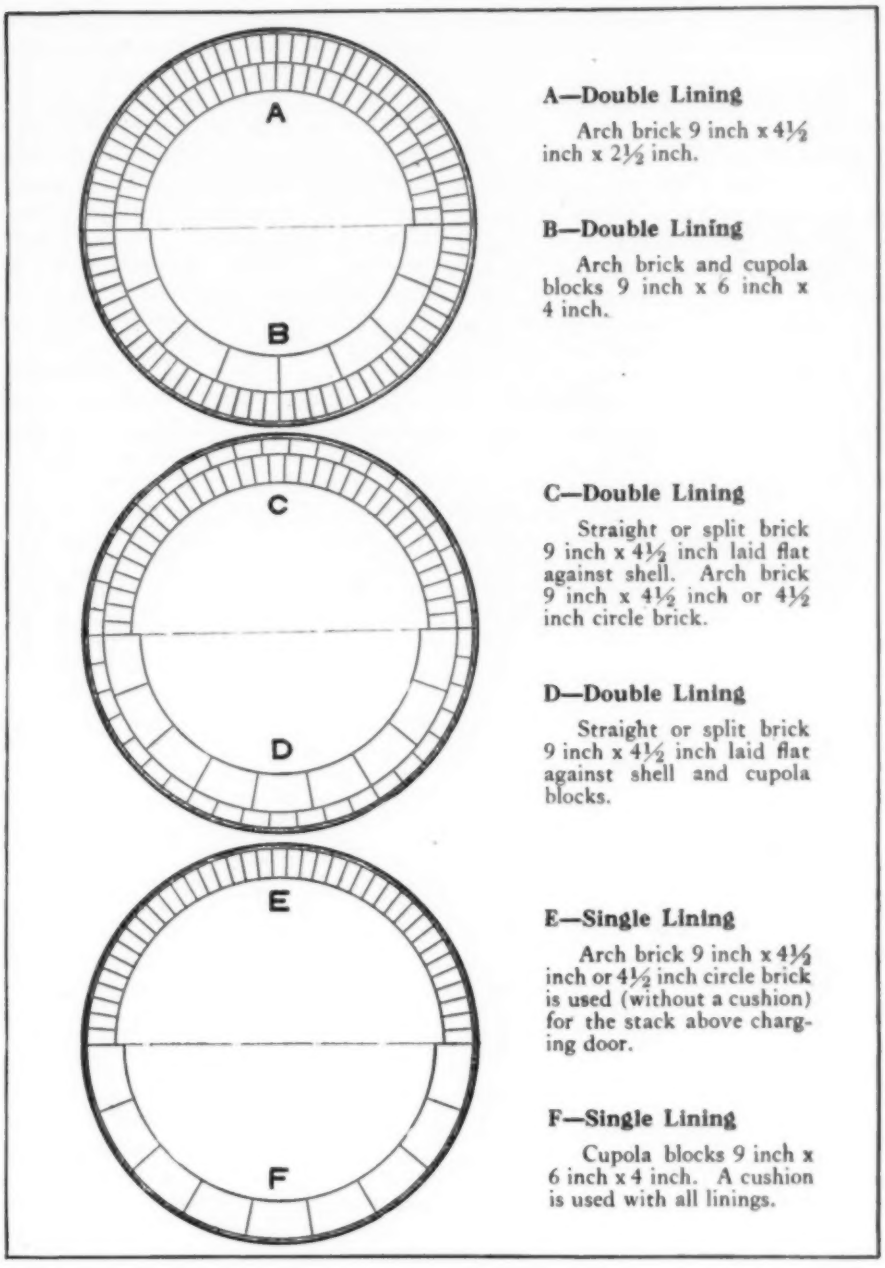

A
B
C
D
E
F
A—Double Lining
Arch brick 9 inch x 4½ inch x 2½ inch.
B—Double Lining
Arch brick and cupola blocks 9 inch x 6 inch x 4 inch.
C—Double Lining
Straight or split brick 9 inch x 4½ inch laid flat against shell. Arch brick 9 inch x 4½ inch or 4½ inch circle brick.
D—Double Lining
Straight or split brick 9 inch x 4½ inch laid flat against shell and cupola blocks.
E—Single Lining
Arch brick 9 inch x 4½ inch or 4½ inch circle brick is used (without a cushion) for the stack above charging door.
F—Single Lining
Cupola blocks 9 inch x 6 inch x 4 inch. A cushion is used with all linings.

FIG. 124.—ALTERNATIVE METHODS OF BUILDING SINGLE AND DOUBLE LININGS IN THE CUPOLA

Principal constitutional changes take place during firing in the free silica or quartz content. Free silica has a comparatively high coefficient of expansion. Under the influence of heat it undergoes certain transformations from the original natural quartz state into two modifications separately known by the mineralogical terms crystoballite and tridymite. These changes in modification are accompanied by volume changes particularly responsible for spalling tendency when changes occur in the subsequent reheating of the bricks. Transformations only are partially accomplished in the original burning of the fireclay. Their extent is determined by the duration and temperature of the burning process. In normal firebrick burning, 75 to 80 per cent of the natural quartz is transformed to crystoballite and tridymite with an accompanying increase in volume of about 20 per cent. Percentage of free silica or quartz as distinct from the clay content in the fireclay, and the correctness of the firing, exert considerable influence on the spalling tendency. From a series of tests, Surecht and his collaborator have shown that the ultimate chemical

composition of the best fireclay bricks show that the ratio

$$\frac{\%\,SiO_2}{\%\,Al_2O_3 + \%\,(Fe_2O_3 + CaO + MgO + K_2O + Na_2O)}$$

falls between 1.5 and 2.6.

Spalling tendency in bricks at a low temperature of approximately 225 to 250 degrees Cent. has been shown to be due to a sudden volume change of the crystoballite, which undergoes an inversion at this temperature. For this reason it is necessary to heat brickwork slowly beyond the temperature indicated and the repeated heating and cooling of brickwork past this temperature should be avoided whereever possible.

Magnesite bricks have the greatest spalling tendency of all refractory bricks. Comparative figures follow showing specific sensitiveness to spalling of common refractories, related to magnesite, at 100.

Specific spalling tendencies in common refractories.

Magnesite brick	100
Silica brick	75
Chromite brick	42
Zirconia	16
Bauxite	13
Fireclay	8-12
Carborundum	2

Pure clay is neutral and fireclay departs from this neutrality according to its content of free silica. Chemical inertness toward basic influences is decreased accordingly. Furnace gases high in carbon monoxide content corrode brickwork, particularly if the bricks contain much oxide of iron (Fe_2O_3). This oxide is reduced to a lower oxide or to metallic iron by the carbon monoxide, which penetrates the pores of the brickwork. With reduction of oxide to iron, carbon is deposited in the pores of the brick and this ultimately is re-gasified with a consequent disruption of the material. Corrosion of bricks in this manner to an extent is determined by the porosity. Fortunately, comparatively rapid glazing of firebrick surface in cupolas prevents any extensive action from this cause.

New firebricks are weaker than used firebricks and should be handled carefully in transportation and in the foundry. Cupola blocks should be handled separately and every care taken to protect the edges and corners. Firebricks absorb water easily and absorbed moisture is particularly injurious, especially in cold weather. Cupola bricks should be kept in a dry place and stacked on dry floors. Firebrick never should be exposed to rain, frost or snow, and new bricks should be dried slowly and carefully to expel any absorbed moisture. Brickwork structures normally absorb a considerable amount of moisture from the jointing material. Hence the necessity for drying the structures carefully.

Firebricks of standard sizes generally are shipped loose. In general practice up to 10 per cent extra are shipped as spares to cover damage in transit. In the United States bricks generally are shipped in box cars. Packing is advisable if not essential with special shapes, and crates generally are made up to about 700 pounds gross weight.

The standard 3 x 4½ x 9-inch brick, made in circle form commonly is used for cupola lining. The bricks are segmental, 4½-inch radial thickness, with a taper determined by the internal diameter of the desired circle. Various other shapes may be utilized according to individual taste. Bricks of larger sizes, commonly referred to as cupola blocks are preferred by many foundrymen for reduction in total number of joints in the brickwork as a whole. Typical shapes of bricks and methods of constructing linings from these shapes are illustrated in Fig. 124.

Brickwork joints generally are made with fireclay. To obtain best conditions, a fireclay is desirable having the same characteristics as that of which the bricks are made. Fireclay should be used sparingly. The thinner the joint the better. The aim should be a brick to brick joint. Firebrick makers prepare special fireclays for jointing purposes. These jointing clays to which a proportion of burnt fireclay has been added change in volume less than green fireclay owing to a portion of their composition having undergone the change which takes place in burning. The fireclay should be prepared as a thin paste into which the bricks are dipped, and then rubbed into place to make a brick to brick joint. From 400 to 600 pounds of fireclay will lay 1000 bricks.

Several available cold setting cements are highly refractory and are marketed under special trade names. These materials set cold like cement to form a hard mass of considerable mechanical strength. These materials are more expensive than ordinary fireclay.

In small cupolas 4½-inch thick brick lining generally is sufficient. A 9-inch lining is recommended for larger cupolas. In all cupolas intended for use over prolonged daily periods or continuously, the minimum lining thickness should be 9 inches and even thicker linings are to be preferred. Usually a space of from ¼ to 1 inch is left between the brickwork and the cupola shell, and this space is filled with loose sand or fireclay. This space never should be left open. Danger exists of the accumulation in this cavity of explosive mixtures of carbon monoxide and air, as a result of the filtration of the gases through the brickwork. An explosion in this cavity possibly might wreck the whole cupola lining.

Steel angle rings, or cast iron segmental rings are bolted to the interior of the cupola shell at suitable levels for supporting the lining. These rings permit extensive mending and relining operations to be performed with safety in the event of damage to the lower portions of the lining.

In ordinary practice, openings

Table XXIV

Typical Analyses of Stourbridge Fireclays

		No. 1	No. 2	No. 3	No. 4	No. 5
Silica	SiO_2	56.11	64.65	50.65	47.40	72.92
Titanic oxide	TiO_2	.....	.....	1.44	1.25	1.26
Alumina	Al_2O_3	26.28	23.67	28.97	33.18	17.22
Ferric oxide	Fe_2O_3	2.51	2.16	2.99	1.72	1.32
Magnesia	MgO	0.11	.....	0.67	0.36	0.27
Lime	CaO	0.94	0.28	0.47	0.38	0.16
Alkalies	K_2O & Na_2O	1.25	0.82	1.68	1.20	0.79
Loss when calcined over 109 degrees Cent.		10.99	8.53	12.92	14.12	6.00

Table XXV

Typical Analyses of Three Special Firebricks

	No. 1	No. 2	No. 3
Silica	81.6	42.6	50.01
Titanic oxide	0.7	1.8	3.61
Alumina	15.0	52.7	40.11
Ferric oxide	1.8	2.5	3.37
Magnesia	0.2	0.2	0.61
Lime	0.3	0.1	0.69
Alkalies	0.8	0.4	1.92
Loss when calcined over 109 degrees Cent.	Nil	Nil	0.24
Refractory test	1670-1690°C	Over 1770°C	1710°C

around the fetting hole, slag hole and tap hole are made up with black sand or loam firmly rammed against the coke and held in position by the breast doors. Tap hole and slag hole are formed daily with a fireclay and sand or a gannister and fireclay mixture in some instances containing a small amount of coke, coal dust or foundry blacking. In certain instances a firebrick tap hole is preferred and special large bricks are manufactured for the purpose containing the tap hole correctly located. Special tap hole blocks also are made from a material similar to that in plumbago crucibles. Similar special runner bricks or spout liners also are available. It is claimed that slag and iron will not stick to this material as they do to ordinary fireclay brick, and it may be expected to last three or four years. It is of interest to note that under ordinary conditions, a ½-inch diameter tap hole will run 5 tons per hour; ⅝-inch diameter, 10 tons per hour and ¾-inch diameter, 15 tons per hour.

Small Foundry Equipped with Conveyors

(*Concluded from Page* 411)

The electric furnace has a capacity of 550 pounds and two types of charges have been used. One charge is composed of 230 pounds of return scrap, 320 pounds of borings and about 5 pounds of ferrosilicon. The ferrosilicon is added to give the desired softness for machining. The other charge which is used regularly is composed of 100 pounds of pig iron, 130 pounds of return scrap and 320 pounds of borings. This mixture gives the following average analysis in the finished castings: Silicon, 2.75 per cent; sulphur, 0.077 per cent; manganese, 0.61 per cent; phosphorus, 0.41 per cent; graphitic carbon, 2.68 per cent, and combined carbon, 0.54 per cent.

Iron of that analysis forms an ideal casting with low sulphur content. The low total carbon gives a high strength cast iron, and the higher silicon range gives it the necessary machining quality. High temperature attained in the electric furnace provides a good pouring temperature and allows the metal to run thin and complicated sections as well as the heavier ones.

In charging the furnace which is cylindrical, pig iron and return scrap are placed in the bottom. Then the borings are placed in the furnace so that they form banks at both ends of the furnace sloping toward the center. This leaves a hollow place in the middle. After the furnace is charged, the current is turned on. Due to the method of placing the charge of iron, an electric arc is not struck because the current finds an easier path through the metallic charge. However, the metal offers a high resistance to the passage of electricity with the result that for a time the furnace acts as a resistance type instead of an arc type. It is stated that the kilowatt demand when the furnace is operating in this manner is about the same as when the furnace is operating as an arc furnace.

Melts the Iron

After a short time the high resistance of the charge generates sufficient heat to melt the iron. Soon after it begins to melt the borings recede from the walls and then away from the carbon electrodes. As soon as the metal leaves the electrode, the arc is struck and the furnace operates in the usual manner. Approximately 1½ hours elapse between one tap of molten metal to the next. Actual melting time only occupies one hour. The remainder of the time is taken up in pouring the metal and recharging the furnace. Cost of molten metal at the spout is stated to be $0.0175 a pound. The borings cost $0.003 a pound, scrap iron costs $0.007 a pound, and electric current costs $0.02 per kilowatt hour. Labor, repair, overhead and depreciation are included in estimating the cost of metal at the spout.

As mentioned previously the castings are taken from the shakeout screen to another part of the shop where the cores are removed. The castings then are taken to the cleaning room which is shown in Fig. 6. Heavy gates and risers on the castings are sawed off by a bandsaw made by William Laidlaw Co., Belmont, N. Y. Clean surfaces on the castings are obtained by placing the castings in a tumbling mill manufactured by W. W. Sly Mfg. Co., Cleveland, or in a sandblast cabinet supplied by Pangborn Corp., Hagerstown, Md. Both the tumbling mill and the sandblast cabinet are connected to a dust separator manufactured by Pangborn Corp.

After this cleaning operation the castings are placed on either of the two gravity roller conveyors shown in the center of Fig. 6 which carry them to the chippers and grinders who remove any small fins, gate or riser projections, etc. The castings are chipped with pneumatic chippers manufactured by the Independent Tool Co., Chicago. Grinding is performed on stand-type grinders made by the firm. Following the chipping and grinding operations the castings pass to a spraying booth where they are given a coat of dark gray paint.

The castings then are transported to the machine shop on skids. Similar to the foundry, the machine shop is arranged for straight line production, and the castings are placed in the lathes, boring machines, etc., in regular sequence so that when the castings reach the end of the line all machine work is complete. After the machining operations are complete, the castings are freed from all grease and chips by passing through an automatic washing machine which sprays the castings with a hot alkaline solution under high pressure. The device is supplied by the Crescent Washing Machine division, Hobart Mfg. Co., Troy, O. After the castings are washed and dried, they are forwarded to the stock room. From the stock room, the castings go to the various departments such as the motor and generator where the windings are placed in position, armature department, etc., or if no further additions are to be made the castings are forwarded to the assembly line as called for.

Stone Companies Merge

Cleveland Stone Co., with quarries at Berea, Amherst, Wakeman, Marietta, O., and Grindstone City, Mich., and the Ohio Quarries Co., with quarries at Birmingham and Amherst, O., have been merged and will operate under the name of the Cleveland Quarries Co. The Sterling Grinding Wheel Co., Tiffin, O., a subsidiary of the Cleveland Stone Co., has been included in the merger. The officers of the new company are: W. A. C. Smith, president of the Ohio Quarries Co., chairman of the board of directors; H. W. Caldwell, president of the Cleveland Stone Co., president; F. D. Kellogg, vice president and treasurer of the Ohio Quarries Co., executive vice president; J. R. Miller, vice president and treasurer of the Cleveland Stone Co., vice president and treasurer.

Publish Code of Ethics

The Foundry Equipment Manufacturers association has published an 8-page booklet containing its code of ethics. The pamphlet also gives a list of the activities of the association, and a list of members and officers.

Earnest V. Pannell, consulting electrical and metallurgical engineer, has moved to the Chanin building, 122 East Forty-second street, New York.

In Defense of the FOUNDRY CHEMIST

Economical Operation Is Almost Impossible Without Information Obtained Through Analysis of Materials

By W. H. Spencer

IN THE checking of raw materials alone a chemist will pay for himself in a foundry of any size. It is well known that all the iron in a carload will not have the same composition. Sometimes this variation is small and the analysis furnished by the furnace will be satisfactory. At other times, however, some of the iron in the car may have a silicon content as high as 2.30 per cent and some as low as 1.40 per cent. These figures are taken from the actual analysis of portions of a car of No. 2 foundry iron. These variations are introduced in several ways. All the iron may not be from the same cast or the pigs may have been mixed in piling and loading. These mixed cars give an average analysis at the foundry different from the furnace analysis and this should lead to an investigation. The result will be that this iron can be used cautiously and after an objection or so the furnace will take more care in handling the iron.

Errors Are Not Rare

Then, again, we may have an even more dangerous condition in that the iron on the car is not even the same grade as that on the furnace analysis. No. 2 iron has been received as No. 4. Some one had made a mistake, possibly one of a dozen men. This class of error is not as rare as could be hoped. Naturally the other elements vary as well as the silicon in this class of irons. Quite frequently a wild car or a mixed car of iron will bring criticism of the furnace on the ground that some mysterious quality is lacking in the iron and that this is the fault of the furnace.

Why guess and take chances on this kind of business when a chemical analysis will tell for certain what is the trouble?

The exact analysis of ferrosilicon, spiegeleisen, and other alloys is essential. These alloys are expensive and cannot be wasted, yet enough must be used to secure the desired results. In this case 2 or 3 per cent variation is not much to the manufacturer, yet it means a great deal to the consumer if much alloy is used. Yet this is one of the minor duties of a chemist. The most important uses of analytical chemistry in foundry-control to be considered are: First, the effects of analyses of flux and coke and then the more important control of the composition of the metal.

Gives Other Side

SOME foundrymen maintain that a chemist has no place in the foundry, except to add to overhead operating expense, and turn the plant topsy-turvy with queer notions on how things should be done. Others are not quite so outspoken but claim that a chemist is an unecessary luxury, and that foundry difficulties can be remedied by foundrymen themselves. This latter attitude and reasons for maintaining it were explained by Victor E. Hillman in "Is Chemistry of Value in the Gray Iron Foundry" which appeared in the April 15 issue of THE FOUNDRY. *Since there always are two sides to every argument, the proponents of having a chemist in the gray iron foundry will find their views ably presented in this article. The author is superintendent of foundry laboratory, University of Illinois, Urbana, Ill.*

Anyone who has ever operated a cupola on a long heat knows that slag is an important feature of the operation. While the slag is free everything is rosy; when the slag goes bad, storms are in sight. Bad slag means not only work for the operator, poor melting and hard wear on the lining, but also it means lost castings due to excessive oxidation and high sulphur metal. Poor slagging of the cupola will give slag inclusions, gas pockets, cold shuts, and brittle castings.

Two causes of bad slag which cannot be blamed on the cupola operator and which can be prevented by a chemical analysis are poor flux and high ash coke. A flux may not contain sufficient fluxing material and have a high refractory content. In this case, additional flux of the same kind does not give relief. If the ash content of the coke is higher than usual, there is more flux needed to remove this extra ash. The additional flux requires more coke with still more ash to melt it. In this way a 1 or 2 per cent increase in ash content is much more harmful than might be thought at first glance.

Will Show Sulphur Content

Coke analysis besides ash and carbon content will show another important thing; that is, sulphur content of the coke. The sulphur pick-up of iron in a properly operated and slagged cupola depends directly on the sulphur content of the coke. Therefore, a check on the coke sulphur is a great aid in locating excess sulphur. The evil effects of sulphur have been discussed much and lately the idea has gained ground that sulphur is not as bad as it has been thought to be in times past. However, if any one feels that high sulphur is harmless in cast iron, let him try to make a casting free of gas pockets from a high sulphur iron poured at the same temperature as he has been accustomed to pour his iron of medium sulphur content. If the high sulphur iron should be hot enough to make a sound casting its lack of machinability and its low impact strength will show its character.

Another set of useful analyses, from the point of view of economy, all too rarely is made. This includes slag analysis and waste gas analysis. The slag analysis will give a check on iron loss and wasted flux, while the gas analysis, in the hands of a competent man, will give a line on wasted coke and improper air supply.

The greatest use for an analytical chemist, however, comes in routine control analysis of the iron during a heat. Silicon, sulphur, manganese, and total carbon may vary from several causes in the melting operation. Excessive oxidation shows up in the abnormal reduction of the silicon, manganese, and carbon content. This iron is not up to standard even if oxidation has not proceeded far enough to be detected by the usual signs such as foaming of the cupola, brown smoke from the stack, and iron particles burning in the slag. Errors in making up charges will show up in the variations of the analysis which will be traceable to this cause if the original analysis of the raw material also is known. When the errors in cupola operation or charging have been detected it requires little additional work on the part of the man who is on his job to eliminate the source of the errors. Meanwhile, temporary corrective measures may be applied immediately by means of ferroalloys and changing the pouring temperatures.

Locate Source of Error

Every important element in cast iron can be controlled by careful and intelligent supervision. Where particular work is done the following limits may be placed on variations: Silicon ± 0.10 per cent, sulphur ± 0.005 per cent, manganese ± 0.05 per cent, total carbon ± 0.10 per cent. The iron can be held within these limits, except for rare occasions, for days; not just for an hour or so. Occasions when these limits are exceeded are due to the fact that unskilled labor is used in charging, someone was not on the job, or that a cupola went bad and the remainder of a heat was completed with it and the iron placed where it would do no harm. The limits given above are not theoretical nor are they hearsay. It is true that they are unusual but, nevertheless, possible where necessary. Naturally, such results are not possible without analytical control of the raw materials and melting operation.

To illustrate a case of trouble-shooting, consider that a foundry is working on an order of castings calling for metal with a tensile strength of at least 30,000 pounds per square inch. To obtain this with the iron on hand it is decided to keep the carbon down. The total carbon is to be 3.40 per cent (± 0.10 per cent). A sample is caught at, say, 8 a. m. The total carbon on this can be determined and checked against a standard inside of 30 minutes. If the total carbon is 3.75 per cent on this sample, the man in charge of the cupola is notified immediately. He knows this metal will have a much lower tensile strength than specified if all other conditions are equal.

The first remedy is to add small steel to the molten metal until the melting operation is back to normal. To cut the carbon he may do one of several things: (1) Increase the percentage of steel in the mix if his metal is not excessively hot; (2) reduce the coke charges or increase the volume of air if the metal is hot. Any of these or a suitable combination of them will reduce the total carbon content of the iron.

IT IS possible to run a foundry without a chemist, but to operate a modern foundry economically and obtain business in the face of competition, a chemist is absolutely necessary. This fact has been proven beyond question."

It may be suggested that the high carbon might not be representative of the metal and might be due to the fact that the high carbon was from the pig iron in the charge. However, if the charges are approximately the same weight as the amount of metal removed at each tap, and if the sample was taken from the ladle and not from the stream, the analysis will be truly representative of the carbon content of the iron.

It is possible to apply the analytical results to other elements as well as the carbon by using suitable means. Thus, we cannot only control the iron, but if anything goes wrong we can discover it and apply a remedy without losing an entire cast.

Making of alloy cast irons, such as copper, chomium and nickel irons, is expensive and without the aid of a chemist, results are entirely unreliable. When alloys are added to the stream, the top of the ladle may contain 0.5 per cent of the alloy and the bottom may have 1.25 per cent if not properly added and mixed. When there is no check on this, the only way is to add an excess of expensive alloy to play safe and even then there may be castings below the minimum specified. That, of course, means the loss of profitable business.

Most purchasers of large quantities of castings and many users of small amounts of castings require a chemical analysis of the metal used in these castings. Obviously their business goes to the foundry which has a chemical laboratory. Of course, if the products of a foundry are of such a nature that the purchaser does not require the analysis this feature is unnecessary. But the time is near when all castings will be given this certificate of character.

Still another and profitable use for a chemist is in the analyzing of lost castings. This will give a line on whether the metal or some other factor was at fault. Once the blame has been placed a repetition of the loss can be avoided. It is true that in this respect many alibis are offered. The only important element not shown in the chemical analysis is the oxygen content of the metal.

If oxides are the cause of the loss they can be traced either in rusty scrap, oxidized pig iron, or faulty cupola operation and will usually show up in the casting as gas pockets (not associated with high sulphur). If the results of the analysis of lost castings are not utilized or if alibis are accepted, the chemist is of no value. A real foundryman, supplied with an analysis of the scrap and having a thorough knowledge of his shop, can place the responsibility for losses properly and after that the remedy may be applied.

It is hardly necessary to say that research without a chemist is impossible.

Some of the objections to a chemist in the foundry which have been advanced are: (1) After a long argument the furnace analysis is found to be correct; (2) the silicon and carbon content can not be regulated, so why find out they are wrong; (3) no use was made of analyses; (4) an analysis will not show the cause of loss in a casting; (5) analysis of the metal is not important if molding conditions are correct; (6) *some places may need a chemist, but we don't.*

Discusses Objections

Let us consider these objections in order (1) A careful check of proper samples by a competent chemist before the argument would have saved the humiliating ending. (2) Silicon, carbon and other elements are being controlled in many foundries. Let any one who doubts this make a visit to a few of the progressive foundries in this country. (3) It is not the chemist's fault if no use is made of his findings. (4) An analysis coupled with a thorough knowledge of the

shop, including sand conditions, will show the cause of loss beyond the possibility of an alibi.

(5) There is something in this argument, but a molder is not going to be able to provide the proper gates and risers if he has no idea what kind of metal you are going to pour into the mold. Shrinkage, and length of life of metals of different silicon and carbon content are naturally variable. Do not expect too much of your molder; he is not a fortune teller. (6) Any foundry making high grade castings requires a chemist. Possibly some foundries get by without one but they could do better work with control of their raw material, melting and metal.

The analytical chemist in the foundry is not set up as a *cure all.* He has a definite place, however. Good molding, designing, pattern making and management are also essential. Control of pouring temperatures and sand conditions are as important as metal control. Physical tests of the metals are as important as chemical tests.

Foundry Has Many Variables

The question of the necessity for a chemist in the foundry boils down to this: We have many variables and the metal composition is one of these. If any one of these variables is neglected, extra time and attention to the remaining ones will not compensate for the neglected one. There is too much tendency to make a pet of one condition and neglect the others. One foundry will make a hobby of sand control, another of chemical analysis, a third one will believe it is all in the molding.

The real secret lies in giving the proper amount of attention to each factor.

In conclusion, there is one other objection to various forms of control. That is the fact that in times past, good castings were made without any of these things. My hat is off to the old time foundryman; he made good castings without the benefit of any of the newer methods. However, business conditions are changing, competition is becoming keener and other methods must be employed or the foundry ceases to make profits.

Foote Bros. Gear & Machine Co., Chicago, has completed plans for consolidation with four related companies. By the plan that company will acquire the Lyle Culvert & Road Equipment Co., the Stockland Road Machinery Co., and the Northwestern Steel & Iron Corp., all of Minneapolis and the Bates Mfg. Co., Joliet, Ill.

Book Review

Foundrymen's Handbook, 6 x 9 inches, 574 pages, cloth, published by the Penton Publishing Co., Cleveland, and supplied by THE FOUNDRY, Cleveland, for $6 plus 15 cents for postage. In London the book may be obtained from the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster, for 30s., postage extra.

In 1922 the first edition of this volume was published and it constituted the first compilation of selected foundry data to be offered to the industry. It was a ready reference work of classified information on all phases of castings production including nonferrous, gray iron, steel, and malleable iron branches, and represented a search for material extending over a period of more than 12 years.

The present edition has been revised carefully and the older material which now is obsolete or seldom referred to has been eliminated. It also has been greatly amplified through the addition of new material as is evidenced by the increase of about 250 pages over the previous edition. As in the early edition much of the information presented has appeared in the data sheets which constitute so valuable a feature of every issue of THE FOUNDRY. However, before compilation into permanent form, these data sheets have been checked and revised to accord with the latest and best practice. The section on specifications in particular has been enlarged to include those most frequently mentioned.

This handbook is divided into nine general sections under which the subjects have been classified to facilitate reference. Miscellaneous foundry data is contained in the first section. This includes among other items, cupola practice, composition of gray iron castings, pressure exerted by molten metal, pickling solutions, chimney design, etc. Weight estimates in computing prices on castings is important to the foundry operator, and this topic is covered fully in the second section. The patternmaker has not been overlooked as one entire section has been devoted to this branch of the industry. This section contains such information as recommended pattern equipment, care of glue, patternshop geometry, and numerous tables for everyday use.

Section IV relates to nonferrous metals and alloys which are described under 58 topical heads which include the mixing and melting of certain alloys, effect of various elements on manganese bronze, properties of alloys, hardening effects of metals on aluminum, and an extended list of formulas for a variety of uses. Specifications are covered in Section V and deal with gray iron, steel, malleable cast iron and nonferrous metals and alloys. This section includes standards from the American Society for Testing Materials, Society of Automotive Engineers, American Welding Society and those from various governmental departments. Section VI is devoted to care and maintenance of equipment while routine analyses are described in Section VII. Methods covered in this section include those for gray cast iron, steel, manganese bronze, coke, limestone, slags, and ferroalloys.

A new innovation in a book of this type is the inclusion of a lexicon of technical terms. These definitions constitute Section VIII, and include practically all terms referred to at the present time in foundry and metallurgical practice. Section IX concludes the book with a collection of miscellaneous tables and information such as conversion tables, weight of a square foot of various metals, microscopic examination of cast iron, brinell hardness numbers, etc.

For a work of this kind the index is an essential feature and in the *Foundrymen's Handbook*, this is unusually complete with direct cross references. This handbook should be in the library of everyone affiliated with any branch of the foundry industry as it will prove of inestimable value in obtaining information quickly obviating the search of widely scattered sources.

Scrap Dealers To Meet

A trade practice conference of scrap iron and steel dealers has been authorized by the federal trade commission, the time and place to be announced later. The conference is intended for yard dealers, who buy scrap from industrial plants and from peddlers, preparing it by shearing into proper lengths or sorting according to quality of iron and steel, and for brokers, who may be considered the wholesalers of the industry, taking contracts for large tonnages from steel mills and filling these contracts by buying from yard dealers throughout the country. The Institute of Scrap Iron & Steel Inc., estimated to represent more than 85 per cent of the tonnage shipped by dealers to the steel mills, is doing preliminary work in preparing the industry for selfregulation under the trade practice conference plan.

John C. Pangborn, vice president, Pangborn Corp., Hagerstown, Md., and his family sailed on the S. S. OLYMPIC, recently for a tour of Europe.

BLAST FURNACE
Operation Affects Quality
of Pig Iron and Castings

By A. L. Boegehold

Part III

ATTENTION has been called to the great variation in the rate of travel of the burden through the blast furnace. Since the process of converting iron oxide to iron requires a certain amount of time, it is not difficult to imagine that too rapid a passage of iron through the furnace will result in incomplete reduction of the ore causing the pig iron to contain some unreduced oxides.

It is a well known fact that the size of the pipe in the top of steel ingots is affected greatly by the presence of dissolved oxides and gases. A completely deoxidized steel will form a large deep pipe at the center and top of the ingot, while a gassing or incompletely deoxidized steel will show little pipe, due to the formation of small voids by eviction of gases from solutions throughout the ingot during solidification, totaling in volume the large pipe which would form if the steel were deoxidized completely before casting.

Working on the theory that oxides dissolved in the pig iron, due to incomplete reduction of the ore, might increase with the speed of ore travel and thus decrease the size of pipe or shrinkage cavity in the casting, the rate of travel of the ore through the blast furnace was plotted against the size of shrinkage cavity in the top of the volume shrinkage test bar. This relationship is shown as Fig. 13. Each point represents the average shrinkage cavity for all cast irons made from one kind of pig iron.

The arrangement of the points indicates that our surmise was correct. It is hard to decide which property is more desirable—that possessed by the completely reduced iron which results in better ability to feed from the riser and gates to the casting, or that of the oxidized iron which solidifies without shrinkage cavities unassisted by feeding from gates or risers. The foundryman must decide this point, depending on his own particular needs.

Shrinkage cavities were measured in castings poured at 2450 degrees Fahr. Castings poured from the same iron at 2275 degrees Fahr. showed no shrinkage cavity at all. The amount of over-all volume contraction of the

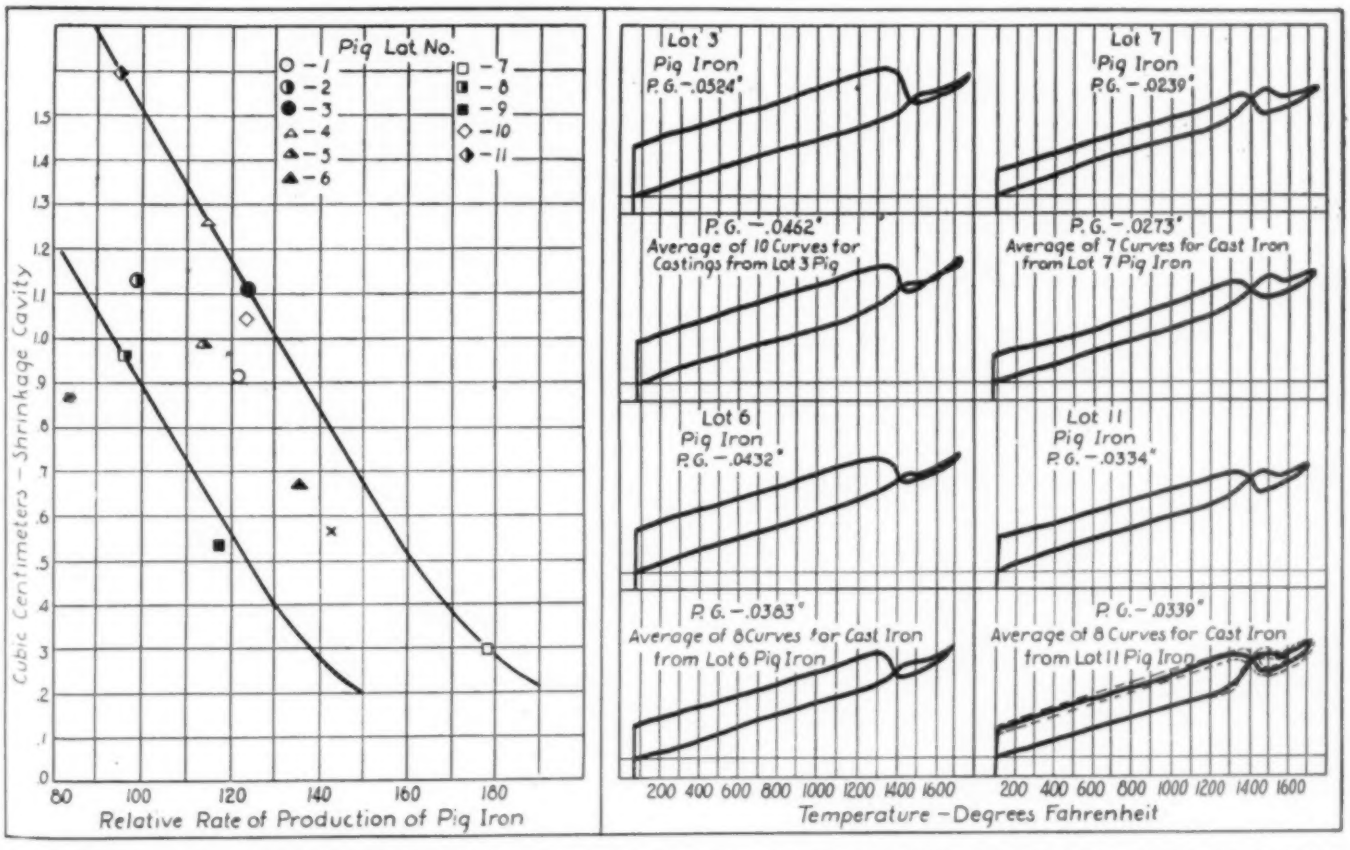

Pig Lot No.
1
2
3
4
5
6
7
8
9
10
11
Cubic Centimeters – Shrinkage Cavity
Relative Rate of Production of Pig Iron
Lot 3 Pig Iron P.G. –.0524"
Lot 7 Pig Iron P.G. – .0239"
P.G. –.0462" Average of 10 Curves for Castings from Lot 3 Pig
P.G. – .0273" Average of 7 Curves for Cast Iron from Lot 7 Pig Iron
Lot 6 Pig Iron P.G. – .0432"
Lot 11 Pig Iron P.G. – .0334"
P.G. – .0383" Average of 8 Curves for Cast Iron from Lot 6 Pig Iron
P.G. – .0339" Average of 8 Curves for Cast Iron from Lot 11 Pig Iron
Temperature – Degrees Fahrenheit

FIG. 13.—POUNDS OF IRON PRODUCED PER SQUARE FOOT OF BLAST FURNACE AREA PER HOUR. SHRINKAGE AS AFFECTED BY RATE OF ORE REDUCTION. FIG. 14—DILATION TEMPERATURE CURVES FOR PIG IRON LOTS 3, 6, 7 AND 11, AND FOR CASTINGS MADE FROM THE IRONS

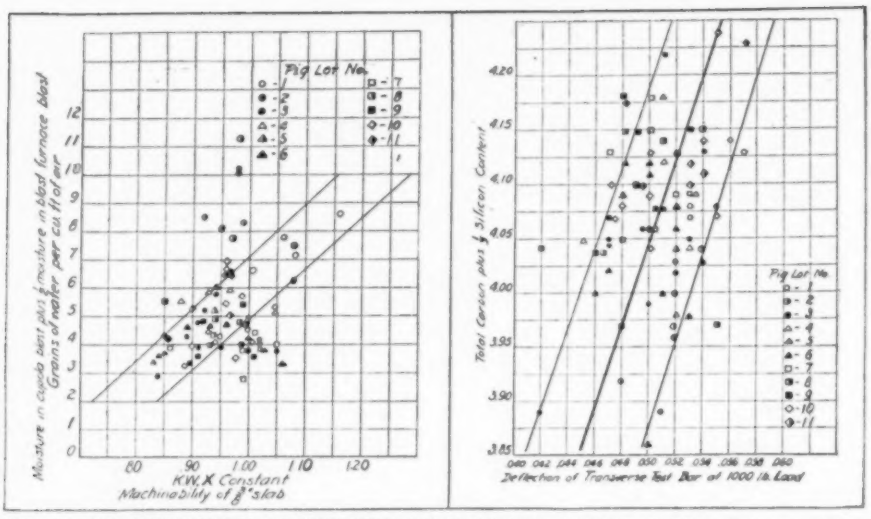


FIG. 15—MACHINABILITY AS AFFECTED BY MOISTURE IN THE BLAST. FIG. 16—RELATION BETWEEN RIGIDITY AND TOTAL CARBON PLUS 1/3 SILICON

various cast irons poured at 2450 degrees Fahr. varied from 3.47 per cent average of irons made from lot 3 pig to 5.16 per cent average of irons made from lot 1 pig. No data were obtained showing the cause for this variation. It is presumably related to oxide content, total carbon, combined carbon content, etc. It must be understood that data given refer only to shrinkage cavities obtained with a given size and shape of casting poured under certain conditions.

It must not be presumed that rate of blast furnace travel in making pig iron is being offered as an explanation for shrinks of all kinds. These data are a statement of results obtained under the particular conditions of our test and not necessarily related to other types of shrinkage. The truth we are trying to establish is that blast furnace operating circumstances confer character upon pig iron which persists through subsequent melting in the cupola and affects definitely the properties of the cast iron it makes.

If it is desired to make pig iron possessing properties associated with rapid travel through the furnace, it can be accomplished by using a fast burning coke and plenty of air. This will cause rapid travel allowing short time for the reduction of the ore. Whether or not this type of iron is desired, it is obviously an advantage to use a fast burning coke because it will respond in rate of burning to the rate at which air is supplied; thus offering an opportunity of positive control to the operator, who then can regulate his speed of ore travel at will by speeding up or slowing down the blast.

With a slow burning coke this control is impossible. For the best control of the furnace the combustibility test, which will be described in Part IV, should be supplemented with a rumble test which will permit selection of coke with uniform resistance to the grinding action in the furnace; thus keeping the charge open for free passage of the furnace gases. At one of the furnaces where we obtained pig iron the rumble test alone was being used with success for controlling the quality of the coke being used.

Thus we see that the quality of the coke has a great influence on several phases of blast furnace operation. It influences:

1. Rate of burden travel which determines tonnage production of pig iron.
2. Time of ore in the furnace which influences the shrinkage characteristics of the iron.
3. Amount of air supplied per ton of iron made.
4. Amount of water passing through furnace per ton of iron made.

Additional evidence that the properties of a pig iron are conferred upon the cast iron made therefrom was obtained in comparing the shape of dilation temperature curves of pig irons and cast irons. Curves shown in Fig. 14 show the dilation temperature curve of various pig irons compared with the average curve for all cast irons made from that pig iron. It will be seen that the dilation characteristics of the pig iron determine those of the cast iron made therefrom. As previously mentioned, the dilation curves for different pig irons differ in amount of expansion and contraction in approaching and passing through the A_c range and in the amount of permanent growth occurring on cooling. It is interesting to note in Fig 14 that large permanent growth is associated with a small expansion and contraction in passing through the A_c range and as this latter phenomena increases in magnitude, the permanent growth of the sample decreases. Note the variation from 0.052 inch permanent growth of sample from pig lot 3 down to 0.024 inch permanent growth for sample from lot 7. In showing the average dilation curve for cast irons made from pig iron Lot 11, dotted lines are drawn in to show the maximum and minimum variation from the average. All curves obtained from eight differ-

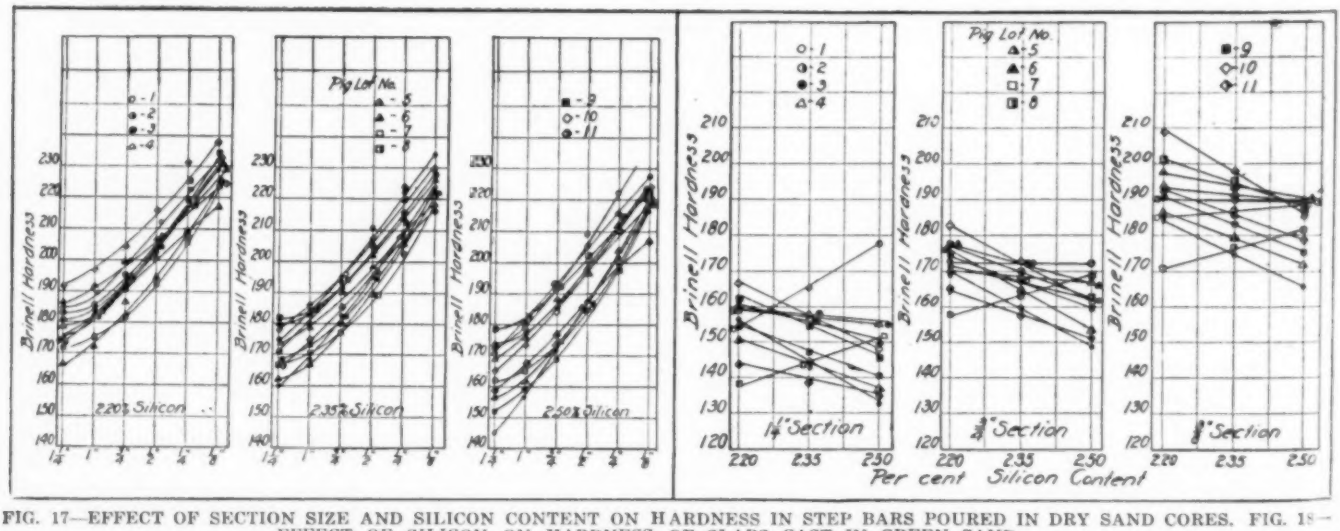


FIG. 17—EFFECT OF SECTION SIZE AND SILICON CONTENT ON HARDNESS IN STEP BARS POURED IN DRY SAND CORES. FIG. 18—EFFECT OF SILICON ON HARDNESS OF SLABS CAST IN GREEN SAND

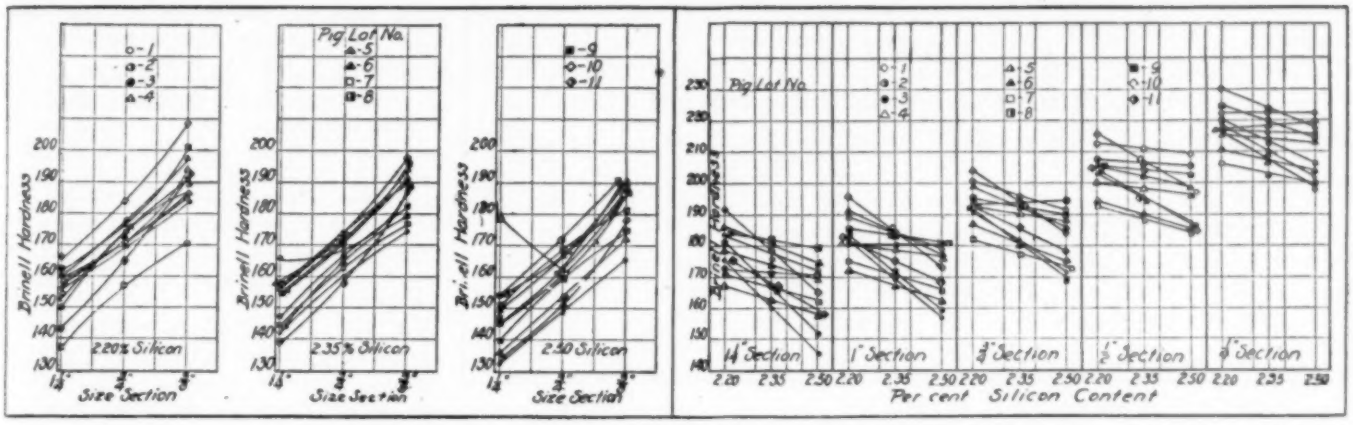


FIG. 19—EFFECT OF SILICON AND SECTION SIZE ON HARDNESS OF SLABS CAST IN GREEN SAND. FIG. 20—SILICON EFFECT ON HARDNESS IN STEP BARS CAST IN DRY SAND CORES

ent heats made from pig iron lot 11 fell between the dotted lines shown.

The similarity between curves for pig iron and curves from cast iron made from that pig is quite conclusive evidence that pig iron quality persists through the cupola melting operation and shapes the properties of the cast iron.

As a subject for further research, the study of the relation between time of burden in blast furnace, liquid shrinkage, and dilation characteristics in causing cracked castings is recommended as being likely to yield interesting and valuable results.

Values of power required for machining the various cast irons plotted against hardness showed a general relation of better machinability for softer irons, but there was considerable difference in machinability of different cast irons of the same hardness. Resorting again to the moisture content of the blast, machinability of the ⅝-inch slabs was plotted against moisture content of the blast, plus one-half of the moisture content of the blast furnace blast during the manufacture of the pig iron used. The result is shown in Fig. 15. The majority of the points suggested better machinability for dryer blast. The points above the band which show better machinability than would be expected from their corresponding moisture content are mostly cast irons made from pig iron made while the furnace was operating slowly, therefore, presumably resulting in complete reduction of the ore.

On the other hand, a good many points below the band showing poorer machinability than is warranted by their value of moisture content were made from pig iron produced in a fast traveling furnace producing presumably incompletely reduced iron. The conclusions that this data suggest then are that:

1. Machinability is improved by removal of the water from the blast.
2. Well deoxidized pig iron makes cast iron which machines better.
3. Pig iron produced too fast makes cast iron which is difficult to machine.
4. When referred to cast irons made from the same pig iron, and under like cupola conditions, softer irons machine better.

The orginal program of investigation assumed we would be able to make cast iron consistently within a narrow range of silicon content. We discovered the interesting fact that it was possible to do this while using

Many Factors Prevail

QUALITY of coke used in a blast furnace affects the rate of burden travel in the furnace, the shrinkage characteristics of the iron, amount of air supplied per ton of iron made and the amount of water passing through the furnace per ton of iron made. Similarity between dilation curves for pig iron and cast iron made from the pig iron show that the pig iron quality persists through cupola melting and shapes the properties of the cast iron. Machinability is affected by amount of water in the blast and the state of reduction of the pig iron. These and other factors such as hardness, tensile strength and specific gravity are discussed in this article which is the third section of a series on the relation of blast furnace operation and quality of iron.

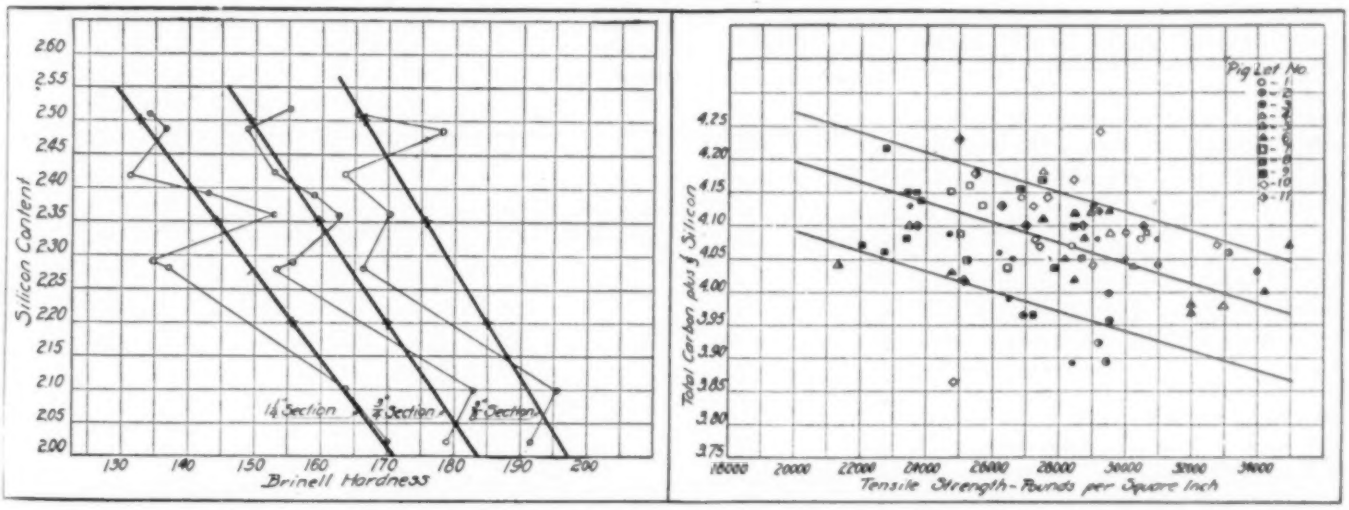


FIG. 21—INFLUENCE OF SILICON ON HARDNESS OF SLABS CAST IN GREEN SAND FROM 9 HEATS OF IRON MADE FROM LOT 3 PIG IRON. FIG. 22—EFFECT OF TOTAL CARBON PLUS 1/3 SILICON ON THE TENSILE STRENGTH

Table V

Variations of Silicon Content

Pig Lot No.	No. of Cast Iron Heats	Silicon Content, Per Cent	Variation
1	4	2.37 to 2.53	.16
2	9	2.01 to 2.51	.50
3	5	2.33 to 2.54	.21
4	10	2.13 to 2.35	.22
5	8	2.15 to 2.43	.28
6	7	2.36 to 2.42	.06
7	8	2.19 to 2.43	.24
8	7	2.13 to 2.38	.25
9	9	2.20 to 2.50	.30
10	8	2.20 to 2.43	.23
11	6	2.15 to 2.48	.33

some pig irons, but with the use of other pig irons the silicon varied considerably. This variation cannot be attributed to any variation of the silicon in a given lot of pig iron, because each lot of pig iron obtained was all from one cast and analysis of several pigs from one lot showed close agreement with not more than 0.11 per cent variation. Table V shows how the silicon content varied in the cast irons made from those pig irons.

The reason why cast irons made from lot 6 pig iron are so uniform in silicon content and why cast irons made from lot 2 pig vary so much in silicon content is not apparent.

The variation in silicon content was used to study the hardness variation. Graphs were plotted between brinell hardness versus silicon content for each group of cast irons made from one pig iron. Values of Brinell hardness were plotted for 1¼, ¾ and ⅜-inch sections cast in green sand, and 1¼, 1¾, ½, ¼ and ⅛-inch sections cast in dry sand core. All curves obtained between silicon content and brinell were irregular. See graph on Fig. 21. The zigzag line connects the points representing irons of like section. These zigzag curves show a trend represented by the heavy line drawn as an average of the points on the zigzag line. The heavy line is assumed to be the line along which the points would all lie if we could eliminate all variables other than silicon content. The heavy line or average silicon hardness curve obtained in this way will be used as the basis of comparison with cast irons made from other pig irons.

By picking values for hardness from these average curves it will be possible to compare hardness with reference to a given silicon content of cast irons made from the various pig irons. In Fig. 17 are shown curves giving the relation between hardness and size section referred to 2.20, 2.35 and 2.50 per cent silicon for iron cast in a dry sand core. In Fig. 19 this relation is given for iron cast in green sand. The most striking fact presented by these curves is the big variation in brinell hardness for irons of like silicon content and size section. Here is iron of 2.20 per cent silicon made from pig iron lot 3 cast in 1¼-inch section in dry sand, giving a hardness of 165, while iron of the same silicon made from pig iron lot 9 and also cast in 1¼-inch section in dry sand, gives 192, a difference of 28 points.

Table VI

Deflection Average

Pig Lot No.	Average Deflection at 3500 lbs. Load for TC +1/3 Si. = 4.05
8	.166
7	.168
9	.171
10	.172
4	.175
11	.176
3	.176
5	.177
6	.177
1	.188
2	.190

The difference is greater in irons containing higher silicons. Iron of 2.50 per cent silicon made from pig lot 7 gives 178 hardness in 1¼-inch section cast in dry sand, while iron made from pig lot 4 cast under the same conditions gives 145 brinell, a difference of 33 points. Variations of the same degree exist in cast irons poured in the green sand molds. What causes this difference is a matter of speculation. The following factors are suggested as possible causes:

1. Rate of production of pig iron which affects the amount of oxides in the pig iron.
2. Amount of water in blast per ton of pig iron produced and in cupola blast.
3. Composition of cupola atmosphere.

Another interesting relationship is the effect of silicon upon hardness of iron in a given section size. This comparison is given in graphs of Figs. 18 and 20. Take for example the effect of silicon on the hardness of irons cast in 1¼-inch section in dry sands. In irons made from pig lot 9 an increase of silicon from 2.20 to 2.50 per cent decreases the hardness 29 points, on the other hand the same difference of silicon in irons made from pig lot 8, causes a drop of only 5 points in brinell hardness. Other irons show results in between these two extremes. The same is true of other section sizes and also for irons poured in green sand. In green sand it will be noted (Fig. 18) that in some cases there was actually an increase in hardness with higher silicon content. No explanation is offered for this phenomena. The results are given as they were obtained.

After results had been obtained from the first six lots of pig iron, the evidence pointed to the fact that pig iron tapped from the blast furnace at a high temperature made softer cast iron than pig iron tapped at a low temperature. Also a hot iron made with a basic slag made cast iron in which the silicon had a greater influence on hardness than in an iron made from pig iron made with an acid slag and tapped cold. The results of the remaining five heats of pig iron did not entirely confirm this theory.

As a means of comparing tensile strength of the various cast irons on a uniform basis, tensile strength of the ⅞-inch diameter as cast bars have been plotted against a composite factor of total carbon plus one-third silicon. The graph of Fig. 22 shows this relation. The points do not fall along a single line, a fact which has been ob-

Table VII

Average Data from Each Lot

Cast Irons Made from Pig Lot No.	Lbs. per Sq. In. Tensile Strength Above or Below Average	Average Tensile Strength Referred to, TC +1/3 Si. = 4.05
10	+3100	32800
1	+2400	32100
11	+2200	31900
4	+2100	31800
8	+ 745	30445
6	+ 675	30375
7	.....	29700
3	— 2270	26430
2	—2380	26320
9	—2400	26300
5	—4100	25600

served repeatedly in all of this work because of the fact that there is probably no property of cast iron which is influenced by or a result of one and only one cause. It is to be expected, therefore, that the points occupy a zone of a width depending upon the magnitude of effect of other factors. The trend indicates a decrease of tensile strength with increasing total carbon plus one-third silicon.

The center line is drawn to represent the average of this trend. Referring to this average line we are able to determine what tensile strength can be expected of an iron knowing its carbon and silicon content.

Referring each of the heats of cast iron to this grand average curve, we find that cast irons made from some of the pig irons have tensile strengths which fall below this average and that cast irons made from other pig irons have strengths in excess of the average. The tensile strength of each heat was compared to the average tensile strength. For example, the tensile strength of cupola heat C-174 is 25,700 pounds per square inch with a TC + 1/3Si value of 4.13. The value of tensile strength on the average curve for a value of 4.13 for TC + 1/3 Si is 24,500 pounds per square inch. Therefore, the tensile strength of heat C-174 is 1200 pounds per square inch over the average. Considering each heat in this manner and averaging the heats made from each lot of pig iron gives us the data of Table VII.

What this difference in tensile strength is due to is not apparent from data obtained. This subject is worthy of the attention of future investigators.

The rigidity of cast iron is indicated by the deflection of the bar during the transverse test on the 1¼-inch round arbitration test bar. Comparison of all the heats has been made on the basis of deflection at 1000 pounds load. This factor has been plotted against total carbon plus one-third silicon in Fig. 16. The points fall in a zone indicating decreasing rigidity with increasing TC + 1/3 Si. The average curve was drawn as in the case of the tensile strength study and degree of rigidity above or below average determined for each heat and averaged for each group of cast iron made from one lot of pig iron. The results listed in Table VII were obtained.

Specific gravity of the cast iron studied shows a variation from 7.159, which is the average for cast irons made from lot 11 pig, to 7.23 average for cast irons made from lot 4. It would seem logical that the denser irons would show bigger shrinkage cavities in the volume of shrinkage test bars but on the contrary irons made from lot 11 pig iron showed greater shrinkage than those made from lot 4.

It will be necessary probably to establish control of some of the many variables affecting the properties of our cast iron before we can establish a relation between specific gravity and factors determining its magnitude—such as oxygen content, other occluded gases, maximum temperature in blast furnace and cupola, with its effect on graphite shape and distribution, amount of combined carbon, silicon, total carbon, etc.

There is considerable variation in appearance of fracture of the various kinds of pig iron. The types of fracture range from coarse open black fracture with large graphite flakes down to fine-grained gray fracture as well as intermediate types containing patches of both. It is not apparent how these conditions are related to the properties of cast iron. The scruff on top of some pig is apparently a function of the pig mold coating and can be completely eliminated by use of a dead burned dolomite mold coating. The only effect of scruffy pig iron upon production of cast iron is to increase the loss of iron by oxidation in the cupola during melting.

Diesel Engines Will Be Discussed at Meeting

Diesel engines will occupy the center of discussion at the annual meeting of the oil and gas power division of the American Society for Mechanical Engineers, to be held at Pennsylvania State college, State College, Pa., June 24-27 inclusive. Design, cost, maintenance and commercial applications of diesel and high-speed oil engines will be discussed. An exhibit of parts and accessories will be held on the ground floor of the armory.

Makes Taxi Stand Sign of Steel Castings

FOUNDRYMEN constantly are finding products which may be made much more satisfactorily with castings than by other methods of fabrication. Recently, the Fort Pitt Steel Castings Co., McKeesport, Pa., introduced the use of steel castings in the construction of signs for marking taxicab stands and for other advertising purposes.

This sign, which is shown in the accompanying illustration, is constructed of three castings, namely the plaque, showing the outline of the cab, the upright stand, with the word taxi on it, and the circular base. The oval shaped piece at the top is bolted to the part which has the word taxi cast in. The upright then is fastened into the base and is bolted under the base. This arrangement provides an underslung construction, and adds to the difficulty of upsetting the entire unit. Another feature claimed for the sign is that it is practically unbreakable.

The sign is finished in any color combination desired to accord with the colors employed by the user. In addition, the word yellow shown in the illustration is interchangeable on the patterns so that other words may be substituted to meet the needs of the user. This also is true with the abbreviated wording in the parenthesis. Because of the distinctive features of this advertising medium, the company has named it the "Sign of the Times."

NortonCompanyExpands

Operations have started on the construction of a new abrasive crushing mill and an addition to the grain storage building at the Worcester, Mass., plant of the Norton Co., manufacturers of grinding wheels and equipment. The new mill will be a 5-story brick and steel structure, 140 x 60 feet, containing equipment for crushing, sizing, washing and drying the grain. The addition to the grain storage building will be a similar 3-story structure, 54 x 117 feet, and will be connected to the crushing mill by covered bridges and a system of conveying equipment.

Questions & Answers on FOUNDRY PRACTICE

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Steel Casting
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

GRAY IRON

Improvement Necessary

QUESTION

We have two cupolas 16 and 25 inches in diameter used for producing plow shares, stone crushers, highway rollers, etc. Our foundry is located in Spain and we have much competition especially from Germany and we are told that their machinery is better than ours. Could you give us any information such as pig iron and casting analyses, blast pressure in cupola, fluxes, etc., that we may better our product?

ANSWER

One of the large manufacturers of plows in the United States makes chilled plow points with the following analysis: Silicon, 1.40 to 1.85 per cent; manganese, 0.50 to 0.75 per cent; sulphur, 0.10 to 0.12 per cent; phosphorus, 0.25 to 0.40 per cent; total carbon, 3.20 to 3.50 per cent.

The mixtures in the cupola vary from 90 per cent scrap and 10 per cent pig iron to 50 per cent pig iron and 50 per cent scrap. The iron is melted hot and poured at about 2500 degrees Fahr. (1370 degrees Cent.) If the points are poured too cold, the chill is low and the surface often is wavy. The chills used in the mold are oiled with light machine oil and inserted in the drag half (bottom) of the mold. The points are gated at the end opposite the nose. If the gates are V-shaped, the gate is placed within the V and is split.

To obtain the desired analysis, you will have to balance the pig irons and scrap that you have on hand. For the lower silicon range you might try 15 per cent steel scrap; 45 per cent pig iron containing 1.8 per cent silicon; and 40 per cent gray iron scrap containing about 2 per cent silicon. For the higher silicon range you might use 15 per cent steel scrap; 350 pounds pig iron containing 3 per cent silicon; and 500 pounds of gray iron scrap containing 2 per cent silicon.

You refer to stone crushers, and by that we presume that you refer to the jaws of the crusher. Iron for this type of work contains from 0.80 to 1.0 per cent of silicon; sulphur, under 0.10 per cent; phosphorus, 0.20 to 0.40 per cent; and manganese, 0.80 to 1.20 per cent. For metal of this type we also suggest that you incorporate steel scrap in the mixture. From 15 to 25 per cent will give better metal, if *handled properly*. Rollers for highways are made from iron approaching the white fracture. White iron would stand the wear best, but it is brittle. Consequently, the iron should have a low silicon content, but not so low as to produce a white fracture.

In melting, the first thing to do is to figure the proper metal charge. An easy way to figure this out will be to make a ring out of brick on the floor with the same diameter as your cupola. This ring should be 12 inches high. Now fill the ring up level with coke, which for example we will say weighs 135 pounds. Divide this weight by 3 which gives 45. Multiply this by 10 which gives the weight of iron per charge or 450 pounds. When steel scrap is used the ratio of coke to iron in the charge should be 1 to 6.

For the bed, we suggest that you put in enough coke to bring the top of the bed at least 30 inches above the top tuyeres if you have two rows, or above the top of the tuyeres if you have only one row. Never put bed coke in by weight, but always by measure. The best way to measure the air is with a pitot tube which gives the volume, rather than by pressure. Theoretically, 1 pound of coke requires 136.8 cubic feet of air to burn it, and if you were melting ½-ton of iron per hour with a coke ratio of 1 to 6, it would require 22,790 cubic feet of air per hour or about 380 cubic feet per minute. If you are not equipped with a pitot measuring tube, the blast pressure for a 24-inch cupola should be about 3.92 ounces or 7 inches of water pressure. Recently a device for weighing the air going into the cupola has been developed which is claimed to give excellent results.

Limestone may be used for the flux. Use about 3 per cent by weight of the iron charge. If this gives too much slag, reduce it to some extent, although we would suggest that you have the slag hole open continuously from about one hour after the cupola is in blast. Fused soda ash or sodium carbonate may be used to advantage in making a fluid slag and removing sulphur.

Q & A

Using Sulphurous Iron

QUESTION

Is there any use in the foundry for the iron by-product left after the sulphur has been extracted from iron pyrites? If not what can be done with it?

ANSWER

The residue left from iron pyrites after the sulphur is extracted is sold to blast furnaces under the name of *blue billy*, and is charged into the furnace in small amounts, so as

not to increase the sulphur in the iron appreciably, a considerable percentage of sulphur always remaining in the alloy.

Q & A

Close Grain Is Needed

QUESTION

Will you kindly recommend a mixture for ring blanks that require a close grain and which will machine readily? The ring blanks will vary from ½ to 1-inch in thickness, from 4 to 18 inches in diameter and from 1 to 12 inches long. A good wearing iron is desired.

ANSWER

A good composition for the rings you want to make and which are presumed to be piston ring blanks, is: Silicon, 2.0 to 2.5 per cent; sulphur, as low as possible; phosphorus, 0.20 to 0.40 per cent; manganese, 0.60 to 0.80 per cent. Steel scrap may be added to the mixture to obtain a closer grain. Probably 10 to 15 per cent will do the trick. Fine-grained iron is tougher than open iron so you may find that it will be a little harder to machine than an open iron, although the difference should not be great.

Some foundrymen advocate the use of nickel to produce an iron that will have a denser structure with good machining qualities. In that case we suggest that you reduce the silicon and replace it with nickel in the ratio of 1 part of nickel to ½ part of silicon. Perhaps 0.5 per cent nickel would help. This would make the silicon 1.75-2.25 per cent.

Q & A

First Iron Melts Cold

QUESTION

We have a small cupola made from an old 56-inch boiler shell lined down to about 28 inches. The four tuyeres, 4 x 9 inches, are supplied with air from a continuous wind belt. The tuyeres are 14 inches above the tap hole and 6½ feet below the charging door. Our coke bed extends 30 inches above the tuyeres and we charge the iron and coke in the proportion of 500 to 50. The iron is hot enough after the cupola has been running for 25 or 30 minutes, but the iron from the first few taps is cold. We shall appreciate your opinion on how to secure hot iron all the way through the heat.

ANSWER

To secure hot iron in the first part of the heat the temperature in the cupola before the fan is started must nearly approach the melting point of cast iron. Raise the bed a few inches and leave the tuyeres open for from half an hour to an hour before starting the fan. You do not give the total height of the stack and therefore we cannot determine whether the natural draft will burn the coke rapidly or slowly. You will have to decide this point from observation. A hard or damp bottom sometimes is responsible for cold first iron. See that the furnace is good and hot before the blast is put on, plug the tap hole with a short length of dry sand core or with a handful of molding sand. Allow the metal to accumulate in the well of the cupola until you can see it through the peep holes and then tap it into a mixing ladle.

STEEL

Quench Thick Sections

QUESTION:

To what depth is water quenching effective in 12 per cent manganese steel? Some time ago the claim was advanced that 6 inches represented the maximum. What is your opinion?

ANSWER:

So far as we know that claim still stands. In *Refining Metals Electrically*, by Larry J. Barton, this point is covered as follows: "Difficulty in obtaining a uniform heat and quench, limits the thickness of section which may be made of this metal (manganese steel). At present the maximum thickness is about 5 to 5½ inches. Heavier sections either are cored, or a carbon-steel insert is placed in the center of the section to act as a more or less solid core. This aids in relieving the great strains which would be caused by such a harsh quench as cold water when acting on a section of greater thickness. The principal reason that manganese steel castings cannot be made in sections over 5 to 5½ inches thick is because heavier sections almost invariably crack inside as a result of quenching stresses.

Q & A

Risers Feed Castings

QUESTION

We are having some trouble with holes under the risers on a cast-steel, saw-mill, carriage wheel 20 inches outside diameter with a web center and extra heavy rim. We shall appreciate your instruction on how to gate and head this casting to secure solid metal. The steel is melted in a side blow converter.

ANSWER

If the holes only appear under the risers it is apparent that these feeding heads are not fulfilling the purpose for which they were intended. Either they are too small in the body or the neck is constricted to a point that causes it to freeze before the casting has ceased to draw metal from the sink head. The logical remedy is to increase the size and possibly the number of risers until a solid casting is secured. You do not state whether the mold is made in green or dry sand, or whether the metal is poured from a teapot spout or bottom pour ladle. Gating detail will vary somewhat depending on these two factors. Also if the mold is made in green sand the risers must be increased a little over the size used on a similar dry sand mold. Thus while four 6-inch risers, one on the hub and three on the rim may be adequate for a dry sand mold, the size should be increased to 6½ or 7 inches for a casting made in a green sand mold. The best way to gate the casting either in a green or a dry sand mold is to carry the hub up straight the full size to the top of the cope and then build a cup with a strainer core in the bottom. If you have a back file of THE FOUNDRY you may find detail of this pouring head in the Sept. 1, 1927 issue, page 692.

Q & A

Wants Crucible Steel

QUESTION

I shall appreciate any information you can give me on the manufacture of crucible steel castings. Occasionally a customer wants a small steel casting. Can the charge be melted in a coke fired pit furnace? What kind of material is used for a charge and where can I get it? Are the castings annealed?

ANSWER

On account of the comparatively high cost, the crucible melting process practically has disappeared from the steel casting field in America. Only those with long practical training and thorough knowledge of steel metallurgy are competent to make castings according to this method. With these two factors in mind you will readily see that the most sensible advice we can give is to tell the customer to get his castings at an established plant where small castings are made regularly. Certainly if you have to make all the necessary preparations only occasionally to melt steel in a crucible, you cannot do it for anything like the price charged by the bessemer, electric or open hearth steel foundrymen.

A special crucible is needed on account of the extremely high temperature required to melt the metal. Where the crucible is recharged and placed immediately back in the furnace it will last for three or four heats. In your case with a long period between heats a new pot would be required each time an order for a casting was received. The ordinary pit furnace designed to melt non-

ferrous metal will not develop a sufficiently high enough temperature to melt steel. Anthracite coal is used for fuel and a forced blast is applied under the grates for a period of approximately 4 hours.

The crucible process is a de-oxidizing, carburizing and cleansing process. The charge is made up of mild steel or wrought iron scrap in small pieces mixed with washed iron containing little sulphur, phosphorus or silicon. The iron adds the required amount of carbon to the steel but silicon and manganese must be added in the form of small amounts of ferrosilicon and ferromanganese. If necessary other elements required in alloy steel are added to the charge in the pot. The castings are annealed. The subject is too involved and too highly technical to be presented in the space at our disposal.

MALLEABLE

Causes Faulty Structure

QUESTION

I am interested in the manufacture, of malleable iron castings and I would like to know if you can give me any information on the cause of picture frame structure in malleable cast iron.

ANSWER

The picture-frame structure in malleable iron, according to Enrique Touceda may be due to a low silicon, carbon, or manganese, malleable iron of a certain composition. Some specimens examined by him had the following composition: Silicon, 0.54 per cent; phosphorus, 0.162 per cent; sulphur, 0.053 per cent; manganese, 0.108 per cent; total carbon, 2.01 per cent. These specimens when polished and etched showed a decarbonized surface border, and inner ring of coarsely laminated pearlite, and within this a core corresponding in structure to that of normal malleable iron, all of which are characteristic of this grade of iron. It is the presence of this ring of pearlite whose ductility is so much less than that of the metal in either the decarbonized border or core that produces the sharp line of demarcation between frame and core. In these particular fractures the frame is fiery bright and finely crystalline and the core black. There are picture frame fractures that show various color characteristics of frame and core, but it will be found that invariably the frame has its pearlite ring of greater or less breadth.

If the sulphur in hard iron is unduly high and particularly if not well balanced by the manganese the castings will show almost invariably a picture frame on fracture. This is especially true if the temperature of anneal is too high for such a composition. If the manganese is too high and not well balanced by the sulphur, the same result will follow.

It has been stated that whether there will be a pearlitic ring or not depends upon the rate of surface decarbonization as compared with the rate at which dissociation of the cementite takes place. Schwartz in a paper presented at the Philadelphia convention of the American Foundrymen's association says that it is possible that in some cases decarburization may take place to a point around 1 per cent total carbon before any graphitization has occurred. Graphitization then will be initiated with great difficulty and especially on cooling below A_1 it will proceed only slowly because of the infrequency of graphite nuclei and a pearlitic rim will be the consequence. However if the metal is more or less completely graphitized before the decarburization takes place, the rim or frame will not appear.

Q & A

Gives Differences

QUESTION

What are the essential differences in shrinking and melting point between white iron as used for malleable cast iron and ordinary gray iron?

ANSWER

Gray iron castings of moderate size may be made of metal containing 2.0 per cent silicon, 0.50 per cent phosphorus and 3.25 carbon as compared to the composition of white cast iron which approximates 0.75 per cent silicon, 0.19 per cent phosphorus, and 2.50 per cent carbon. The white iron will begin to freeze at 2390 degrees Fahr. (approximately) and the gray iron at 2250 degrees Fahr. Consequently the gray iron just begins to freeze at a temperature about 140 degrees below that at which the white iron begins to freeze.

Other things being equal in white and gray cast iron, more shrinks or porous areas will exist in white than gray cast iron. This is due to the longer freezing range of the white iron corresponding to a larger fluid contraction of the still liquid alloy between the time and temperature of incipient and complete solidification. As the temperature of complete freezing is approached, a sufficient volume of liquid to fill the voids in the previously formed solid skeleton no longer remains. Therefore in the last freezing areas voids exist between the dendritic crystals of the first piece of metal frozen solid.

Solid contraction or as it is more commonly known pattern shrinkage of white iron, is ¼-inch per foot as compared to ⅛-inch per foot for gray cast iron.

Q & A

Are Not Drop Forged

QUESTION

What data have you on making dies for dropping malleable castings? Do foundries make their own dies or is there some one who specializes on this work?

ANSWER

We do not understand just what you refer to by dies. As far as we are aware there is no such operation as drop forging of malleable.

Some malleable castings are press formed to get an accurate finish and others are straightened under the drop hammer. In the case of press fitting or forming, a die is used and the casting is formed under a pressure of 100,000 pounds per square inch.

Dies for power hammers are heavy castings with low total carbon content. Steel scrap may be used to advantage to assist in lowering the carbon. The following analyses will serve for power dies:

	Per Cent Medium	Per Cent Heavy
Si.	1.50	1.25
Mn.	0.60	0.80
S.	0.05	0.06
P., under	0.20	0.20
T. C.	3.00	2.75

Steel dies of either plain carbon or alloy steels are used a great deal also.

Q & A

Encounters Brittleness

QUESTION

We make malleable castings, some of which later are galvanized by the purchaser. He complains that some of these castings are brittle after galvanizing and wants to know the cause. Is there such a thing, and is there any remedy for it?

ANSWER

Your difficulty has been experienced by many manufacturers of malleable castings which are galvanized, and a great deal of investigational work was carried on to discover its cause and remedy. One firm claims to have developed a method for treating the castings before galvanizing which eliminates any embrittlement. This consists in heating the regularly annealed castings to a temperature of about 1200 degrees Fahr., and then quenching suddenly in hot water with a temperature around 175 degrees Fahr. The process was described in

detail in the March 15, 1926 issue of THE FOUNDRY under the title, "Embrittlement in Malleable is Avoided."

GENERAL

Castings Dirty on Top

QUESTION

Blowholes and other imperfections appear when a cut is taken from the cope side of some of our iron castings. Our foreman claims that the castings should be designed in a manner that would allow the finished face to be molded in the drag. He claims that impurities rise to the surface and show on the cope side. The teeth on our small gears do not come clean from the sand and we are wondering if our molding sand is responsible for the trouble in both instances. We are sending a sample for analyses and inspection and will appreciate your opinion.

ANSWER

The scope of THE FOUNDRY activities does not include testing or analyzing sand or other foundry materials. You can have the work done by any one of several commercial laboratories whose advertisements appear in advertising pages. However, from an ordinary examination of the sample of sand submitted coupled with your description of the defects on your castings we are inclined to the opinion that the sand is not sufficiently refractory. Also that its lack of refractoriness is due to the amount and—perhaps to some extent—to the character of the bond. Your foreman is right in his claim that impurities float to the surface. Therefore temporarily relief may be obtained by reversing the position of the casting in the mold. That is only a makeshift and presents many disadvantages. In many instances it may entail greatly increased molding cost. The proper remedy is to provide a mold that will not generate impurities that float to the surface. Do not infer from this statement that sand is the only cause of impurities. Other factors contribute their share under certain conditions, but in the present instance from evidence submitted, the sand appears to be responsible for the defective surface of some castings and for the teeth in the small gears that do not strip readily.

If you are buying your sand from a reputable sand producer, you can request him to send you in the future a more refractory sand and one considerably lower in bonding material. If, as we assume from your geographical position, you are using a local sand you can increase the refractoriness and decrease the bond by introducing a certain amount of silica sand, or any clean washed sand. The exact amount only can be determined by experiment. Offhand we should say 10 per cent will be sufficient for ordinary green sand molds. The amount may be increased for molds that are to be dried. This applies to molds for brass and iron. To insure the best results, the new molding sand and sharp sand should be mixed in a mechanical device, for example one of the muller type in which the sand is blended under one or a pair of rollers revolving in a pan. Satisfactory results also are secured in a trough type of mixer in which the sand is agitated and mixed by a series of paddles attached to a revolving central shaft. Even with mediocre sand, clean teeth in many instances may be secured on small gears by the simple expedient of having one man shake blacking from a bag while a second man with a bellows or air jet blows the blacking against the sides of the sand teeth in the mold, first from one side, then from the other.

Q & A

Burning on Steel Plates

QUESTION

In welding a plate of steel to cast iron by pouring molten iron against the steel, would you consider that the use of silicate of soda would make as good a flux as coating the steel plate while hot with borax? In both cases the steel plate would be ground free from scale and rust. When using silicate of soda, the plate would be allowed to dry before placing in the mold. It has been suggested that powdered ferromanganese be sprinkled on the silicate before it dries. What do you think of the idea? Can you suggest any other flux for this purpose?

ANSWER

Foundrymen use various substances for coating steel plates or iron pipes that later have cast iron poured around them. Some advocate linseed oil, chalk, etc., and others employ silicate of soda or heavy lubricating oil. Sometimes the surface against which the iron is poured is tinned. One advantage of the tinned surface is that it is clean. It must be or the tin would not stick.

The first requisite of burning on a steel plate is that it must be absolutely clean. If there is the least oxide on the surface, molten iron will not stick. Therefore the plate must be cleaned by grinding or sandblasting to remove every particle of rust and oxide. After this is done the plate may be coated to keep it in that condition. We suggest silicate of soda as it is easy to handle. However, any of the others mentioned may be used for the purpose if it will give a coat impervious to the atmosphere and moisture.

We do not believe that borax is so good because the plate must be heated to enable it to stick. This heating in our opinion may be enough to allow the plate to oxidize, and the iron will not stick as well. Besides we think that when the plate cools after the borax is applied, the borax glass has a tendency to crack off due to the unequal expansion of metal and glass.

We do not know whether there would be any advantage in adding ferromanganese. Perhaps it might be a detriment in that it might form a hard manganese chill at the joint if it remained at this point without diffusing through the metal. You would have to determine this by experiment.

If possible have the steel plate as warm as can be handled before placing in the mold, then cover and pour immediately. This will insure that no moisture is present on the plate. Usually if the plate is allowed to stand in the mold for sometime before pouring, moisture condenses on its surface from the damp sand. Another suggestion for obtaining a good joint is to allow a certain amount of molten metal to flow over the face of the steel, then the overflow channel is plugged and the rest of the mold filled. This system is used in making vises that have steel-faced jaws. The iron used should be as hot as possible. The hotter it is, the better.

Q & A

Pickle Cleans Castings

QUESTION

Will you advise us what is the best solution for pickling small gray iron castings, and how it is mixed? The pickle desired is for thoroughly cleaning the castings.

ANSWER

Hydrofluoric acid may be used to clean gray iron castings, and is preferable to hydrochloric (muriatic) acid because it attacks only the sand and not the iron. A pickle containing hydrofluoric acid may be made as follows: Water, 76½ gallons; 30 per cent hydrofluoric acid, 15 gallons. Use commercial acid and the density of the solution should be 1.026 at 80 degrees Cent. (176 degrees Fahr.). If the density is less than that add more acid to bring it up. The acid bath is worked at 60 to 80 degrees Cent. (140 to 176 degrees Fahr.). During immersion the castings should be well shaken and dipped several times to bring the solution into contact with all parts of the casting. When the solution gets brownish and deposits form on the casting, it must be discarded.

This acid may form corrosive skin burns, so care must be taken to wash off any acid that may come into contact with the skin of the operator.

Problems in Nonferrous Founding

By Charles Vickers

Bronze Bushings Leak

We would like to obtain an alloy suitable for bronze bushings for service on water-jacketed journal bearings. The castings are 6 inches inside diameter with a ⅜-inch wall when finished. We have tried a mixture composed of 50 per cent bronze of 88-10-2 composition with 50 per cent of good red brass scrap. The castings were made in green sand molds; were cast on end, using an oil sand core, but they came porous and would not hold water at 35 pounds pressure. The alloy was melted in a coke-fired furnace and a charcoal covering was kept on the metal during the time it was melting.

Use the following alloy: Copper, 82 per cent; tin, 7.5 per cent; lead, 5.5 per cent, and zinc, 5 per cent. Melt the copper first under charcoal and when molten, but not hot add 2 ounces of phosphor-copper containing 15 per cent of phosphor. Stir and heat again for 10 minutes. Then add the white metals. The addition of 1 per cent of nickel in place of that amount of copper would be of considerable assistance in densifying the alloy. Add the nickel when the copper is molten and just after the phosphor-copper. Get this alloy *hot* in the furnace, but regulate the pouring temperature to suit conditions. The range 2100 to 2150 degrees Fahr. should give good results.

Q & A

Alloys Will Expand

We would like to learn if there is any suitable pattern metal which will expand on cooling sufficiently to offset shrinkage. We occasionally are using gated patterns of small parts, which we would like to run on aluminum plates without going to the trouble of making new master patterns and new gated patterns from which to cast the plates. For instance, we have a gate consisting of spool-shaped castings with the flange missing on one end, about 1½ inches long and ¾-inch in diameter. If we could make from this gated pattern a casting in a metal that would make the resulting pattern about 1/64-inch larger, then we could use this temporary expanded pattern to cast an aluminum plate on which the patterns would be the same size as the original. We understand there are expanding metals which are too brittle for ordinary use, but in this case we only need to use the pattern once, that is in the case of the aluminum plate. Also, do you know of a formula for a white pattern metal that is nonshrinking and would produce white metal castings of exactly the same size as the pattern from which they are cast. We are using a mixture that is fairly satisfactory, but which does have a shrinkage of 1/32-inch or more to the foot.

To work out this problem it will be necessary to carry out a certain amount of experimental work to decide on an alloy or mixture of metals that will possess the amount of expansion desired. The following alloys are regarded as *expansion* metals and will afford a selection: (1) 56 per cent antimony; 37 per cent lead, and 7 per cent bismuth; (2) 42.25 per cent lead; 42 per cent bismuth, and 15.75 per cent tin; (3) 75.25 per cent lead; 16.5 per cent antimony, and 8.25 per cent bismuth. These alloys, of course, are likely to be brittle and of no use themselves as pattern metals, but if they give the expansion desired it will be possible to transfer them into patterns of the correct size in a suitable pattern metal. We have no data in regard to the amount of expansion of these alloys.

The following alloys are known as *unshrinkable* pattern alloys: (1) 58.50 per cent tin; 22 per cent zinc; 12.50 per cent lead, and 7 per cent antimony. (2) 50 per cent tin; 48 per cent zinc, and 2 per cent bismuth.

Q & A

Is Bearing Alloy

Please give us a good mixture or formula for bronze motor bearing castings of the type that are used in mine locomotives.

The following alloy will give good service: 78 per cent copper, 10 per cent tin, 10 per cent lead and 2 per cent zinc.

Removes Oxides in Lead

We remove the lining from scrap journal bearings by heating a few of them at a time in a bath of the same composition of lining metal, melted in an iron pot of approximately 5000 pounds capacity. The dirt and grease burn off and the reclaimed metal is used half and half with new metal, yet the results are not always satisfactory as the new bearings lined with this mixture, frequently show pin holes after the lining has been broached. Can you suggest a standard practice of fluxing, poling and skimming which we could apply to the old metal to clean and refine it thoroughly, and so eliminate the porosity trouble?

There are a number of different methods and fluxes for refining reclaimed lead. One well-known method is to sink weighted wirework containers to the bottom of the kettle and boil the molten lead. Sticks of green wood are placed in the containers and cause the bubbling. A number of charges may have to be used as the deoxidizing process may require several hours' time. This process simply removes dissolved oxide which renders the lead *thick*. We suggest the following procedure: Mix together caustic soda (common lye) 3 parts and powdered sulphur 1 part. The caustic must not be permitted to come into contact with the operator's hands and the dust should not be inhaled. Heat the lead to around 800 degrees Fahr., and treat with about 2 per cent of the flux, stirring it in after the water of crystallization has been driven out of the lye. Allow the flux to act for a few minutes, then skim it off. It may be necessary to repeat the operation. After the flux has been removed scatter powdered rosin on the metal surface and rabble it a little. The lead now will be thin and fluid and will cast into bearings without being porous. However, it can be deoxidized by the addition of 2 ounces of metallic sodium per hundred pounds of lead. The sodium should be kept under kerosene, to prevent its explosion.

Molds Large Casting

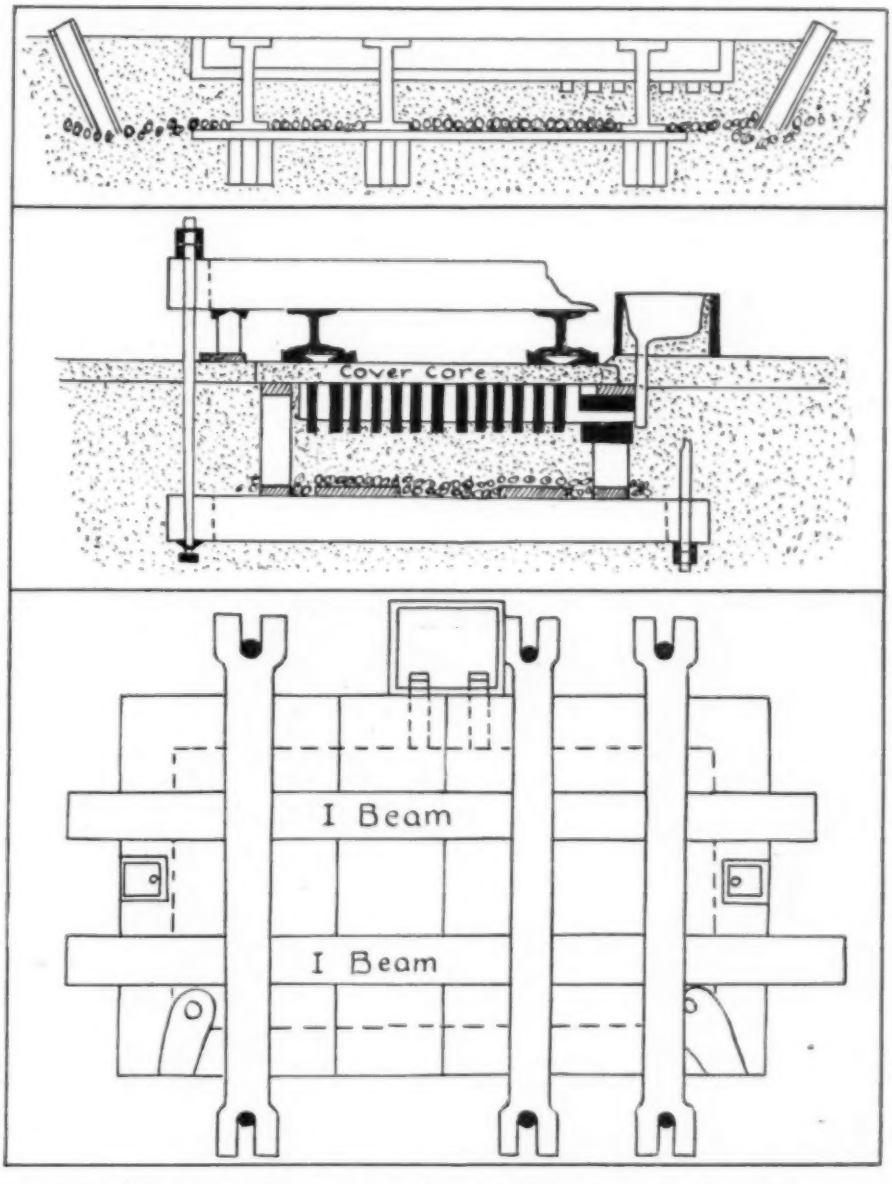
In Small Foundry Having Limited Facilities

By J. H. Eastham

A SHIP repair plant placed an order for two flanging blocks with a small local foundry. These blocks were plain rectangular cast iron slabs 4 x 8 feet, 3½ inches thick and pierced with 255 holes 1½ inches in diameter spaced equidistantly over the entire surface. Each block weighed approximately 4000 pounds. The only lifting device in the shop was a chain block suspended from a monorail that extended from three molding floors to the cleaning room, but did not serve the cupola. The customer supplied a plain box pattern open on top, made from 1-inch lumber with a stiffening rib in the center. The core prints were turned up in long sticks, then cut to the correct length and nailed in straight lines on 2⅝-inch centers over the drag face of the pattern. Two full coreboxes were supplied with the pattern. Lacking a flask, the mold was made in the floor and covered with a set of flat cores 2½ inches thick, 18 inches wide and 6 feet in length. A plain frame for making these cores was knocked together in the foundry. The cores were made from a strong oil sand mixture and heavily rodded.

A pit 2 feet deep, 6 feet wide and 10 feet long was dug in the floor under the monorail. Three binders were placed in the bottom of the pit, one about a foot from each end of the mold and the third a little off center to leave room for the runner box. A coke bed was placed on top of sand rammed to the top of the binder bars and a short vent pipe was set near the center at each side of the pit. Floor sand then was rammed up to within 5 inches of the floor level. A level bed formed with the aid of two parallel straightedges was rammed to the proper density and vented thoroughly before the final facing sand layer was scraped off flush. The straight edges were removed and the pattern lowered into position. The pattern was rapped down gently to leave an impression of the core prints and then removed, after stakes had been driven into the sand at the corners to guide it into position later when again lowered. An opening for each print was secured by pushing a brass sprue cutter 1½ inches diameter to a depth of 1½ inches. With the pattern again in place and the

(*Concluded on Page 436*)



Upper—Detail of Binder, Coke Bed and Vent Pipes. Center—Transverse Sectional View of Closed Mold. Bottom—Plan View, Showing Method of Adjusting Binders

FIG. 1—A Measured Quantity of Sand Is Discharged from the Hopper

Mechanical Equipment *Triples Production* of French Foundry

By Vincent Delport

European Manager, THE FOUNDRY

CONSIDERABLE reduction has been effected in labor, space, number of flasks and cost of production at the Societe Anonyme des Usinese Rosieres, Bourges, France, since a mechanically controlled molding circuit has replaced the previous methods employed in the foundry.

The company specializes in the manufacture of flat castings, or castings presenting only a slight relief and utilized mostly for the construction of stoves, heating apparatus, etc. The equipment now used in the foundry was planned by the company engineers and presents many new features. It is known as the Rosieres-Bachon molding machine.

Equipment, including the mold conveyor, has been developed for continuity and automatic working, for the actual molding operations and for the execution of the numerous elementary actions that accompany the making of molds. Perfect synchronization exists between the various movements. Each part of the equipment has its definite function and each workman has his special task with the object of attaining the greatest possible efficiency. The workmen operating the machinery adapt themselves to its rhythm, which may be varied within certain limits.

This machine permits the utilization of the pattern plates and flasks formerly used with the hydraulic molding machines. The 12 series of flasks range in size from 700 x 500 x 115 millimeters to 1200 x 825 x 115 millimeters (4½ x 18 x 28 to 4½ x 32½ x 47¼ inches).

Equipment shown in Fig. 6 includes

Roll the Sand

WHILE the idea of rolling sand instead of compressing it by direct jolt or squeeze, is not new, an ingenious application of the rolling principle has been installed in the foundry of the Societe Anonyme des Usines de Rosieres, Bourges, France. Three rollers are mounted in a fixed frame and impart a squeezing action to the sand heaped in flasks that pass below on a moving conveyor. The managing director of this company is H. Magdalenat who with E. C. Ronceray headed the French foundry delegation at Detroit, Sept. 27-Oct. 1 1927.

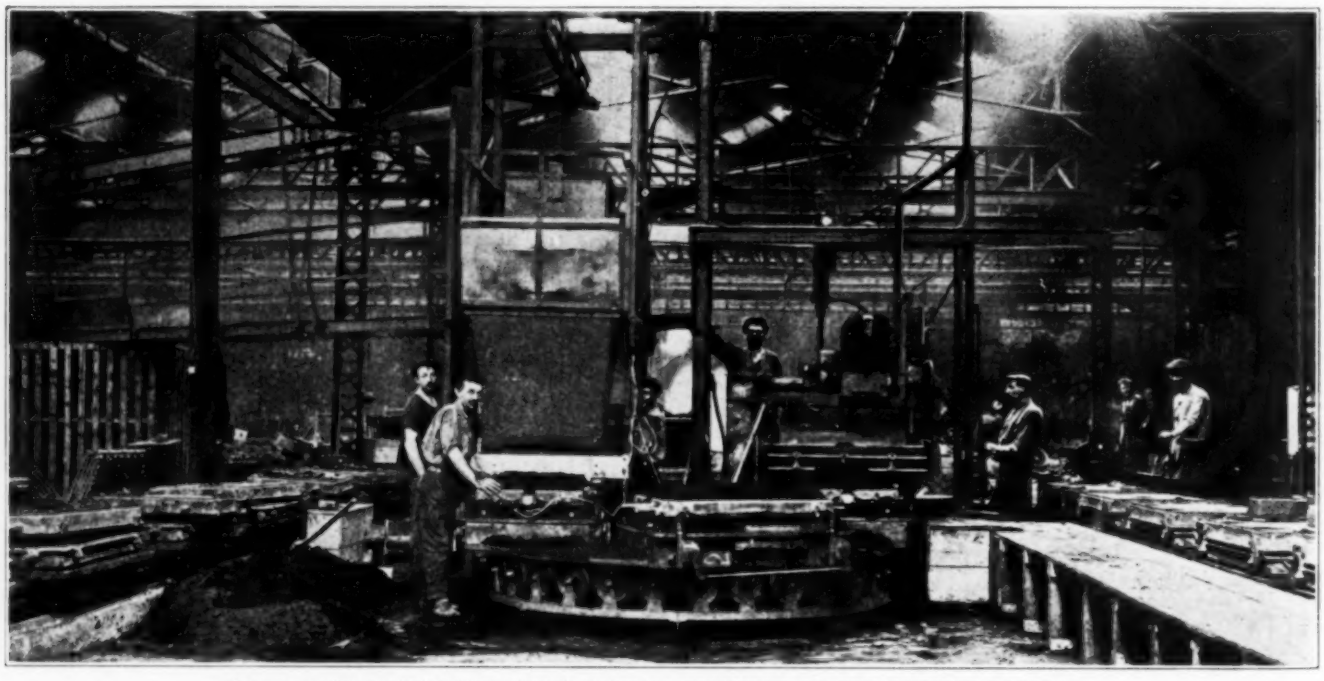


FIG. 2—THE FLASK FILLED WITH SAND IS CONVEYED TO THE SQUEEZE ROLLERS

one complete molding station and a conveyor for finished molds encircling the molding station. Six molding tables, shown in Fig. 6 at 22, carry the pattern plates arranged alternately for the drag and cope. Consequently the entire circuit may produce three complete molds either alike or all different, at each revolution.

The molding circuit and the conveyor for finished molds travel in opposite directions. When the molding table with its pattern plate passes point 24, an empty flask is placed upon it. This also is shown at the right side of Fig. 5. The molding table then passes at 25 under a first sand hopper and in doing so it opens the bottom of the hopper, which closes again automatically when a given quantity of sand has fallen into the flask. This sand is tucked under the bars and rammed around the sides and ends of the flask by hand as shown in Fig. 1.

The flask then passes a second sand hopper which also opens and closes automatically to release the necessary amount of sand for the completion of the mold. Molds leave the sand hopper as shown in Fig. 2 and travel toward the squeezer where the sand is rammed mechanically. Molding tables and molds pass under three squeezing rollers shown at 27 in Fig. 6.

This feature marks a new departure in methods for compressing sand in molds. THE FOUNDRY on several occasions has presented descriptions of plants where heavy rollers are employed to compress the sand. The flask remains stationary while the roller moves over it from one end to the other end. In the ingenious French foundry installation shown in the accompanying illustrations, the three rollers revolve in stationary journals while the flask filled with heaped sand passes beneath. The method resembles that employed in a printing plant where a revolving drum presses a sheet of paper against a flat, type filled form attached to the bed of a press which travels back and forth horizontally under the revolving roller.

FIG. 5—THE PATTERN IS DRAWN AUTOMATICALLY AND THE MOLD IS LIFTED BY A PNEUMATIC HOIST CONTROLLED BY A PEDAL

After the sand has been squeezed, the flask is lifted automatically from the pattern at 28 and maintained in that position while an operator attaches it to an air hoist at 29. This part of the operation also is shown in Fig. 5.

The drag is lifted first and rolled over through an angle of 180 degrees while it still is suspended from the hoist. Then it is placed on four supports indicated at 30 which are connected to a pneumatically operated piston. Further details of this part of the operation are shown in Fig. 3. The cope is handled in the same manner, except that it is not rolled over. At point 30 it is placed on the drag and the complete mold is lowered by the pneumatic piston on to the table of the conveyor which carries it away.

This sequence of operation is repeated steadily throughout the day for the manufacture of a series of molds in flasks of the same type. Pouring commences at point 31. The conveyor brings the poured molds to point 34, where each mold is lifted from the conveyor and shaken out over a grate shown at 38 in Fig. 6. The empty flasks are placed on the machine and once again sent through the cycle of operations.

Small flasks are shaken out by hand, but the heavier flasks are lifted by an air hoist indicated at 35. This hoist moves along a monorail, 36, which rotates around a column, 37. The entire unit is driven by a single 5-horsepower motor. Speed of the finished mold conveyor is regulated according to the speed of the molding circuit. One table of the outside conveyor passes point 30 while two tables on the molding circuit are passing point 28. The length of the conveyor for finished molds is based on the time necessary for cooling the castings to the point where they may be shaken out safely.

The rhythm of production may be regulated at will by changing gears

FIG. 3—THE DRAG IS CLEANED WITH A JET OF AIR BEFORE THE COPE IS LOWERED INTO POSITION. THE COMPLETED MOLD IS PLACED ON ONE OF THE CONVEYOR TABLES. FIG. 4—GENERAL VIEW OF THE INSTALLATION WITH THE MOLD MAKING UNIT AT THE BACK AND THE POURING STATION SHOWN AT THE LEFT

in the drive. Molds may be prepared at a speed of one complete mold in 50, 55, 60, 70 seconds or more if necessary. The equipment constitutes a complete, mass production, molding unit, taking up a small amount of space. Workmen to operate the machine are trained in a few minutes. Each one has only a small number of well defined movements to make. They must keep pace with the speed of the machine.

made, poured and shaken out in 70 seconds. The crew of 11 men includes the foreman and the men who transport the sand from one point to another. With flasks 95 x 385 x 850 millimeters (3¾ x 15 x 33½ inches) ten men make a complete mold in 55 seconds. The record output for this size flask was one mold in 42 seconds during a whole working day. Men engaged in pouring the iron and in other miscellaneous work are

Addresses Newark Group

F. D. Campbell, chief engineer, Eastern Steel Castings Co., Newark, N. J., principal speaker at the regular monthly meeting of the Newark Foundrymen's association at the Downtown club, Newark, April 24, stressed the importance of adequate and properly arranged material handling equipment to a jobbing foundry. He described the system of labor sav-

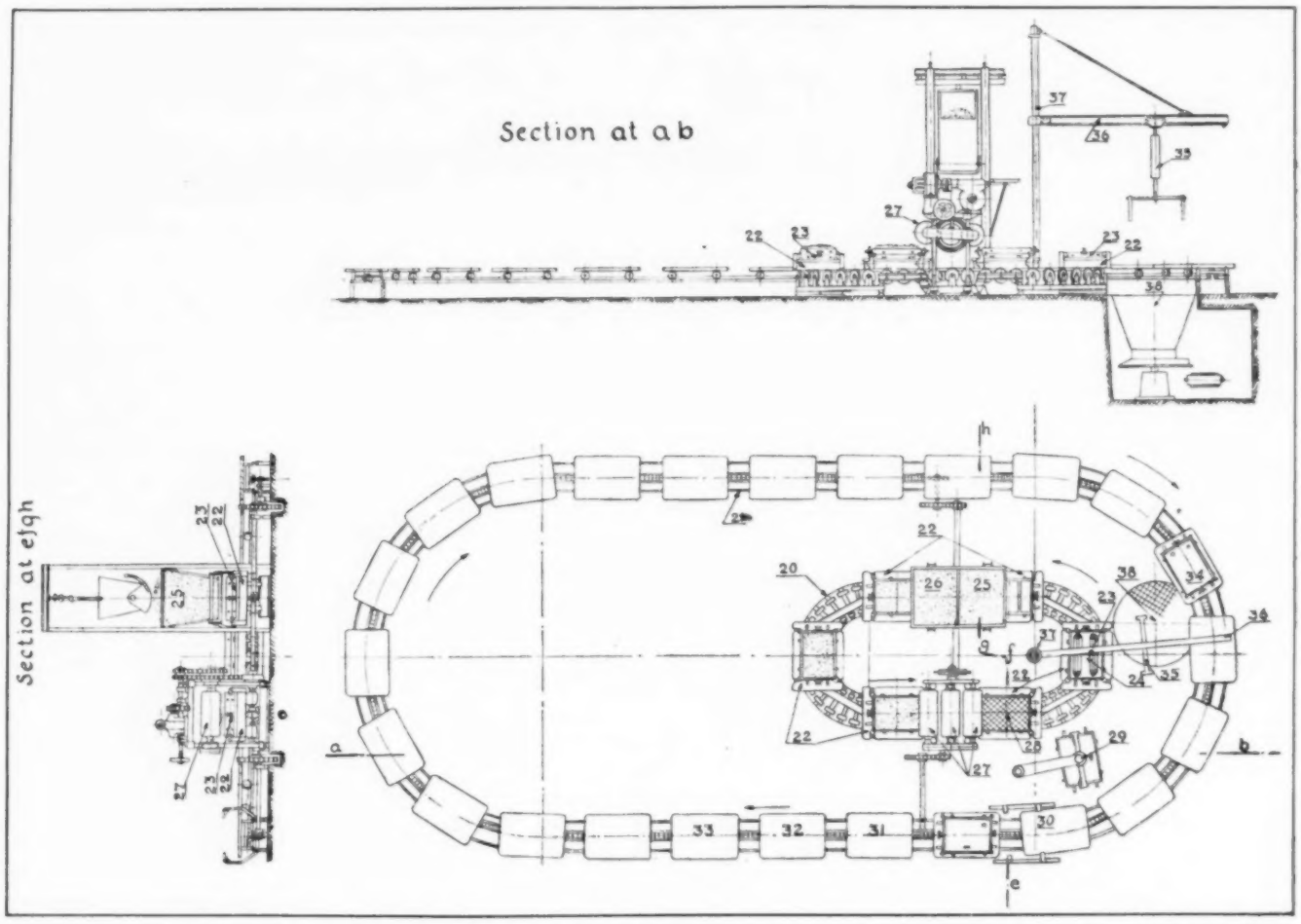


FIG. 6—GENERAL LAYOUT IN PLAN AND ELEVATION OF THE MOLDING UNIT RECENTLY INSTALLED AT THE PLANT OF SOCIETE ANONYME DES USINES DE ROSIERES, BOURGES, FRANCE

Number of flasks required is reduced, because they are utilized constantly in the two circuits that pass continuously from the mold conveyor to the conveyor for finished molds and vice versa. At the Rosieres foundry only 30 complete sets of flasks are utilized for each series of castings for practically unlimited production. Before the installation of the present equipment, 150 flasks were needed for the same purpose.

The output of the machine is considerable and is limited only by the time necessary for the air hoist to pick a flask up from the molding table and place it on the conveyor.

With flasks 105 x 605 x 995 millimeters (4 x 23¾ x 39 inches) inside dimensions, one complete mold is

not included in this report.

Improvement in certain details of the machinery probably will result in still larger output from a well trained personnel. It is estimated that the output of the shop has been trebled in comparison to that formerly obtained when ordinary hydraulic molding machines were used. Area of the present unit is only one-third of that formerly required for a similar output. The fact that sand is required only at one point to fill the flasks simplifies the sand handling problem.

The American Refractories institute will hold its annual meeting at French Lick Springs hotel, French Lick, Ind., May 21 and 22.

ing equipment recently installed in the Eastern Steel Castings plant. More than 75 per cent of the orders are for quantities of 50 or less and the great percentage of the work is in light castings at that plant. Another speaker, affiliated with the same company, outlined a wage incentive plan employed, based largely on a set of standards for each of the various departments in the plant. Other speakers who participated informally in the meeting were G. E. Diescroth, of the General Electric Co., Elizabeth, N. J.; H. G. Specht, Eastwood Wire Mfg. Co., Newark, and David MacIntosh, Sacks-Barlow Foundries Inc., Newark. John Carter, president of the association, reported on the Gray Iron institute meeting in Chicago.

The FOUNDRY Family Photograph Album

Upper Left

E. M. AYERS

Ayers Mineral Co., Zanesville, O.

Lower Left

GEO. MORTIMER

William Mills Ltd., Birmingham, England

Upper Right

J. E. MULLEN

National Foundry Co., Erie, Pa.

Lower Right

F. W. MEYER

National Radiator Corp., Johnstown, Pa.

ALUMINUM BRONZE DATA

(*Continued from Data Sheet No.* 764)

Properties of the 10 per cent alloy in the cast state are little below those obtained in the worked, and all the alloys are highly resistant to acid attack and to oxidation at red heat. Resistance to shock and to pro-

Table II

MECHANICAL PROPERTIES OF CU-AL ALLOYS

(CONTAINING UP TO 10 PER CENT ALUMINUM)

(Rosenhain)

Reference Number	Composition per cent Copper	Aluminum	Manganese	Condition	Strength* Yield point	Breaking stress	Ductility Elongation % on 2 inches
VIII. 7	92.24	5.76	.....	Sand Casting	4.8	17.8	67.0
				Chill Casting	6.0	18.8	61.0
				Rolled Bar	11.8	28.4	74.2
VIII. 8	93.27	6.73	.....	Sand Casting	4.8	18.65	.....
				Chill Casting	.....	19.96	69.0
				Rolled Bar	10.4	28.85	71.0
VIII. 9	92.65	7.35	.....	Sand Casting	6.6	21.3	71.0
				Chill Casting	.....	21.58	84.0
				Rolled Bar	10.6	29.68	72.5
				Cold-Drawn Bar	24.6	31.42	48.0
VIII. 11	91.33	8.67	.....	Sand Casting	9.8	28.1	48.0
				Chill Casting	.....	30.8	55.0
				Rolled Bar	11.1	36.7	38.0
VIII. 12	90.62	9.38	.....	Sand Casting	9.7	30.38	36.25
				Chill Casting	10.5	33.98	43.50
				Rolled Bar	17.7	38.00	34.00
				Cold-drawn Bar	29.0	38.83	32.00
VIII. 13	90.10	9.90	.....	Sand Casting	11.3	31.70	21.7
				Chill Casting	12.4	36.93	30.5
				Rolled Bar	14.8	38.10	28.8
				Cold-drawn Bar	40.4	43.94	13.0
IX. 2	89.06	10.02	0.92	Sand Casting	14.00	35.76	22.5
				Chill Casting	16.00	39.90	25.0
				Rolled Bar	23.04	42.84	22.5
				Cold-drawn Bar	42.00	50.04	16.0
IX. 3	88.00	9.99	2.01	Sand Casting	13.20	34.44	24.0
				Chill Casting	16.80	37.00	25.0
				Rolled Bar	21.40	40.72	29.0
				Cold-drawn Bar	40.88	52.08	10.0
IX. 6	88.11	8.91	2.98	Sand Casting	10.80	31.60	24.0
				Chill Casting	14.80	34.40	26.0
				Rolled Bar	20.00	40.00	39.0
				Cold-drawn Bar	38.92	44.00	22.0

*Tons per square inch.

longed fatigue stresses, is a valuable property of aluminum bronze. Probably the only nonferrous metal with which it can be compared usefully in this respect is manganese bronze, and according to W. M. Corse, aluminum

(*Continued on Data Sheet No.* 766)

ALUMINUM BRONZE DATA

(*Continued from Data Sheet No.* 765)

bronze resisted stresses above its elastic limit for an average of 15 million reversals in a White-Souther machine, while manganese bronze broke at less than 1 million. In the Landgraf-Turner endurance testing machine the aluminum bronzes resisted 4500 blows before fracture, while the manganese bronze resisted about 500.

Other workers have commented on this feature of the aluminum bronzes, and some of their findings are tabulated in Table IV. Translated into practice, it means that castings or forgings in this material may be designed with scantlings far lighter than are safe with other bronzes. They may be subjected to stresses little short of their ultimate strength as indicated by the ordinary test bar.

Table III

EFFECT OF IRON, NICKEL AND MANGANESE ADDITIONS

Composition Al	Fe	Ni	Mn	Condition temperature in degrees Fahr.	Yield point lbs. per sq. in.	Tensile strength lbs. per sq. in.	Elongation % in 2 in.
9.26	3.07	.....	.....	As Chill Cast.	35,700	80,900	24.8
9.26	3.07	.....	.....	1700 Water	37,900	88,000	19.8
				800 Air			
9.16	0.51	.....	1.74	As Chill Cast.	29,300	69,100	47.5
9.16	0.51	.....	1.74	1700 Water	30,600	75,800	23.8
				850 Air			
8.73	0.24	4.05	.....	As Chill Cast.	38,700	64,100	46.3
8.73	0.24	4.05	.....	1700 Water	32,200	43,100	6.3
				850 Air			
8.31	2.44	.....	.....	As Sand Cast.	28,000	75,500	48.5
8.31	2.44	.....	.....	1700 Water	44,300	80,400	30.8
				850 Air			

Reprinted from *Aluminum Bronze*, by Jerome Strauss, with acknowledgments to the author and the American Society for Steel Treating, Cleveland, Ohio.

The foundryman, once he has mastered the art of producing sound work with reasonable precision, will not only find his market broadened, but will also discover economical factors of a certain interest. Apart from the light sections which may be offered safely, the specific gravity of the 10 per cent alloy is 7.5 as against 8.45 for the 75/25 brass. Therefore, he can make 100 castings in aluminum bronze for a weight of metal which will produce only 90 in brass. Aluminum bronze may be die-cast readily, and it is being die-cast in quantities in England as a matter of routine, so opening up to industry a source of light engineering parts of high strength, and of an intricacy which does not permit either of pressing or forging. Table VI shows some properties of die castings.

(*Continued on Data Sheet No.* 769)

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Research To Govern *Specifications* For Cast Iron Pipe

AN ELABORATE schedule of work in connection with the preparation of new standards for cast iron pipe and special castings is announced in a progress report just issued by the sectional committee. This body, which is known as the "sectional committee on specifications for cast iron pipe and special castings," was organized in 1926 under the auspices of the American Engineering Standards committee, which now is the American Standards association. The sectional committee was sponsored by the American Gas association, American Society for Testing Materials, American Water Works association, and the New England Water Works association. It consists of 39 men representing producers, consumers and others having general interest in this subject. The committee has organized three technical committees and others have been added to the membership of the latter and their subcommittees so that the total membership exceeds 100.

The three technical committees are No. 1, on dimensions; No. 2, on metallurgy, processes and tests; and No. 3, on corrosion and protective coatings.

Technical committee No. 1 on dimensions has the following subcommittees: 1-a, on barrel of sand cast pipe; 1-b, on bell and spigot dimensions of cast iron pipe including lugs and harnesses; 1-c, to consider all types of pipe other than sand cast; and 1-d, on fittings.

Technical committee No. 2 on metallurgy, processes and tests has been given the task of investigating pig iron and other raw materials entering into cast iron for pipes, melting practice in the casting of pipes, and acceptance tests relating to the strength of the pipes and the quality of metal in them.

This committee has the following subcommittees: 2-a, raw materials and melting practice; 2-b, metallurgy and chemistry; 2-c, physical tests and test specimens; and 2-d, experience.

Technical committee No. 3 has six subcommittees, each of which has been assigned problems in connection with the theory of corrosion, study of coatings and experience regarding water and soil corrosion.

From the standpoint of producers, the work of the subcommittees under technical committee No. 2 on metallurgy, processes and tests are of chief interest. The subcommittee on raw materials and melting practice will consider materials entering into the manufacture of cast iron pipe up to and including the molten state. If this committee should decide that it is not desirable to specify actual composition of the melt, it will so report and give its reasons therefore.

The apparently injurious effects on the quality of cast iron caused by forced output from blast furnaces and from cupolas, the quality of some domestic and imported pig iron now on the market, practical limits in the use of scrap of various kinds, and quality of coke and limestone are some of the questions to be considered by this subcommittee.

The subcommittee on metallurgy and chemistry will make all chemical analyses of metals for the other committees and will consider the desirability of chemical specifications in general for composition of metal in the finished castings.

The subcommittee on physical tests and test specimens has been assigned the task of studying the question of test bars, test specimens and other physical acceptance tests for pipe, and carry on such experimental testing in relation to acceptance tests as may be recommended. An extension of the Talbot tests to other sizes of pipe is one of the suggested lines of study. This committee also will study and collect and analyze test bar data and experience with test bars and other specimens. It will also study the relationship of the strength and deflection of bars to the desirable and undesirable properties of pipe as shown by experience. It also has been asked to study the propriety of substituting the new arbitration bar for the 2-inch and 1-inch bars.

A great deal of the information to be collected by the sectional committee is being obtained by means of a questionnaire which has been sent to over 1000 superintendents of water and gas plants. The returns so far received show that valuable information is being obtained, much of it of a nature never before collected and which will deserve very careful study and require much work on account of its volume. The questions in the questionnaire are grouped under the following headings:

1. General information.
2. Dimensions.
3. Failure of pipe.
4. Barrel of vertically sand cast pipe.
5. Bell and spigot joints for vertically sand cast pipe.
6. Special types of pipes.
7. Fittings.
8. Metallurgy and tests.
9. Internal corrosion.
11. Bituminous coatings.
11. Cement linings and coatings.
12. Soil corrosion.
13. Hydraulics.

The questionnaire is soliciting the

Test Pipe at Three Universities

UNDER the direction of technical committee No. 1, trench load tests which will give new definite information on earth loads are being conducted at Iowa State college. Technical committee No. 2 is directing tests at the University of Illinois on the strength of cast pipe. The methods used by Professor Talbot on 6-inch pipe now are being employed on 20-inch pipe. At the Massachusetts Institute of Technology, tests are being made on the corrosion in water of cast iron pipe of various chemical compositions. Specimens are immersed up to a maximum time of 300 days. These tests are being conducted under the direction of technical committee No. 3.

views of the best men, both superintendents or operators and consulting engineers concerned with cast iron pipe from all three aspects, production, use and general interest, as to such changes in specifications as they would advise, and valuable information of their experience in the use of pipe of various kinds is being obtained.

On all of these tests the pipes come from foundries in different parts of the country and are not specimens picked for the tests but are the ordinary run of pipe, with the view that all tests should give information which will apply to average conditions. Complete information is recorded of all details of manufacture of each piece of pipe so that everything possible will be learned and published to connect cause and effect of all phenomena observed. Published reports will be made of the information available from the tests, from the questionnaire and otherwise, without waiting for the issuance of a final report, so that all information obtained will be available to those interested as completely and as early as possible. Through the generous and enlightened policy of the producers and certain of the users, over $60,000 has been made available for use in the research activities of the sectional committee.

E. A. Wilcox Co., has opened offices, warehouse and display room at 273 Seventh street, San Francisco.

Makes Large Casting in Small Foundry

(*Concluded from Page* 431)

guide stakes removed, two flat gate cores were butted up against the pattern at the center of one side with the gate openings about ⅛-inch above the bottom line of the pattern. Upright gate sticks were adjusted against the outer ends of the cores. A cast iron stool was placed on the outer end of each binder bar, just inside the bolt slot and with the top flush with the parting line of the mold. Sand then was rammed around the pattern up to the floor level. Pieces of flat plate were bedded in the sand at the joint to serve as a safety factor while fastening down the covering cores.

After the pattern was removed the cores were inserted in their prints, one row at a time, commencing at one end of the mold and slicking around each core as set. This method assured a set of approximately perpendicular holes in the casting. Plumbago facing was rubbed on the face, the sides and the end of the mold. Nails were inserted in the sand close to a few cores in the vicinity of the gates to prevent any movement under the impact of the flowing stream of iron.

A pinch of flour was placed on top of each core to insure a *touch* with the flat cover cores. With all the cover cores in place, two lengths of 8-inch steel I-beams were lowered into place longitudinally with the ends resting on plates bedded in the sand beyond the ends of the mold, and with the under surface clearing the cover cores by 1-inch. The upper binder bars were placed directly on the long I-beams and with the ends over the corresponding ends of the binders in the bottom of the pit. The bolts were tightened all around and then wedges were tapped in between the lower face of the I-beams and the upper surface of the cover cores. Suitable blocking on the outer ends of the cores was wedged in a similar manner under the binder bars.

The casting was poured from a 20-per cent semisteel mixture. The metal was carried from the cupola in bull ladles and dumped into a crane ladle suspended from the chain block. Shortly before the mold was filled, metal from a 200-pound bull ladle was poured through a pop gate at each end.

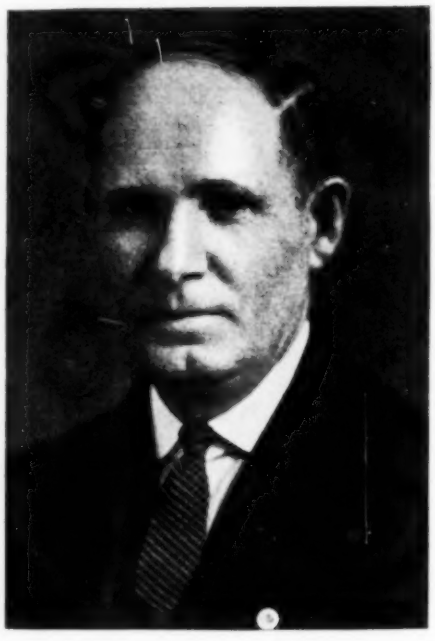
Expands Facilities

Leeds & Northrup Co., 4901 Stenton avenue, Philadelphia, has acquired additional property including a one-story manufacturing building with 85,000 square feet of floor space adjoining its plant. The new building will be joined to the present building with a connecting wing.

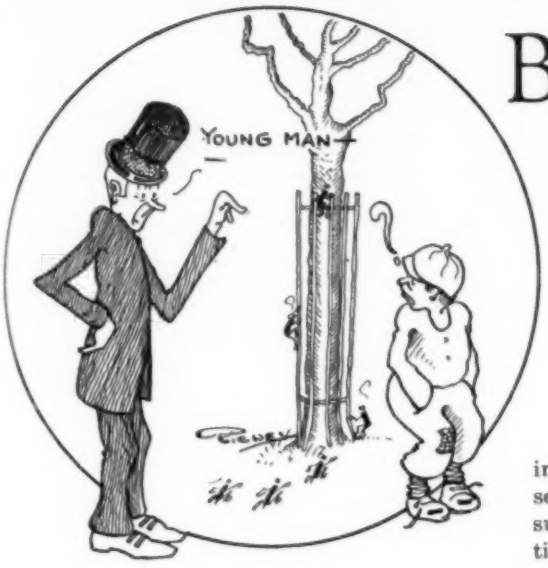
To Present Series on Steel Foundry Practice

BEGINNING with the June 1 issue, THE FOUNDRY *will publish a series of articles on steel foundry practice with particular emphasis upon the production of high quality metal in the open-hearth and electric furnaces. In addition, the series will include discussions of pouring practice, selection of refractories, heat treatment and problems in management. A discussion of the future of the steel foundry from an economic viewpoint also will be included.*

The articles have been prepared by Charles W. Veach, open-hearth superintendent, Bettendorf Co., Bettendorf, Ia., who has had a great deal of experience in that work. Mr. Veach is a member of the American Institute of Mining and Metallurgical Engineers and is the author of many articles for the technical press. His knowledge covers many years of practical experience coupled with a theoretical knowledge obtained by constant study of the principles and practice of metallurgy. Mr. Veach also has completed several extensive courses in foremanship under Iowa State college, Ames, Ia.



During the past years, determined efforts have been made toward the improvement of open-hearth design and control, and toward the constant improvement of the quality of the metal for steel castings. Mr. Veach tells of these improvements and gives the modern methods used to produce quality steel castings.



Bill Studies Mysteries of Core Oil

By Pat Dwyer

ONE of the many things impressed upon me—forcibly at times—in my youth, was that time, T-I-M-E, is the most precious of all the blessings and so forth, placed at our disposal by a beneficent Providence. In season and out of season I was told by all kinds of people that time once lost was gone forever, vanished, vamoosed, evaporated, shot to pieces.

I suppose the gift or ability to keep silent under this form of persecution is part of the price which one must pay for the privilege of enjoying youth. When people—any kind of people—preach that doctrine to me now I tell some of them they simply are wasting their time. Others I invite placidly to take a long running jump in the lake where it is good and deep, but in his early and down trodden days a lad has to learn to walk—and talk—discreetly and circumspectly.

The human mind, taking it by and large, is so curiously constituted that these poisonous reptiles probably thought they were performing a meritorious service in their self-imposed task of keeping others in a state of feverish activity. Wagging a solemn, and sometimes not over clean forefinger by way of emphasizing the statement, they never tired of repeating what they implicitly believed was a verse from the Bible: "Satan will, find mischief still, for idle hands to do!" Although they never tired of repeating this poetic and sage admonition, I know I tired easily and early of hearing it. What is more to the point I figure—and this on a conservative basis—that I must have lost in the aggregate, at least three and one-half (3½) full working days idly speculating on where and how they secured this inside and presumably confidential information from the camp of the enemy. I am still in ignorance as to how it was obtained.

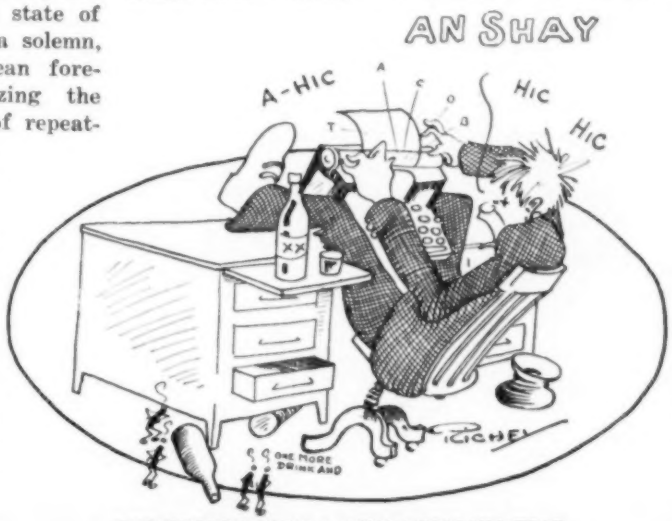
This is not a plea for or defense of laziness. Despite a popular misconception to the contrary, idleness and laziness are not synonymous terms. Because a man's hands and feet are idle it does not follow necessarily that his brain is in the same condition. On the other hand, the fact that a man's brain is active while the other members of his body are at rest, does not necessarily imply that the man is thinking of carving his favorite enemy into a number of small pieces, or of doing a neat bit of burgling in one of the homes of the idle rich.

While I was in school, toiling and moiling like a brave little beaver, I tried on sundry and divers occasions to explain to several teachers the difference between idleness and laziness, but I regret to say without the slightest success. Possession of the irresistible force known as duly constituted authority rendered these old crabs immune to argument, logic and ordinary common sense.

Sometimes I escaped with the idle-hands-verse ringing in my ears. At other times the ears rang from a different cause. Occasionally the hands were reduced to a condition that rendered them immune to Satan's wiliest temptations. In strict justice I must admit he suggested some perfectly gorgeous ideas had the hands been in good working order.

Occasionally, in recent years, I get a letter from a lad in the East which shows that a man apparently may be idle and still be engaged in highly meritorious work. According to all the rules, regulations, tips, inside dope and sign posts leading on to fame and fortune, he is wasting his time when he takes his pen in hand and filches a priceless hour to compose one of these precious epistles, but when you lay all your preconceived prejudice to one side and consider that the reception of these letters affords me the keenest pleasure, you must admit that his time—and time—are not wasted.

His latest effusion is a whimsical commentary on the behaviors of a remarkably intelligent horse who—perhaps I should say *that*, but this is the story of an exceptional horse, so we'll let that *who* stand—who pulled the plug from a water barrel with his teeth and then slaked his thirst by sucking the water through the bunghole. My friend professed to see nothing remarkable in the incident. Any intelligent horse could pull off a little stunt like that. If (he wrote) the horse had pulled the bunghole out of the barrel and slaked the plug with his thirst, the incident might be worthy of mention. If he had pulled the plug out of his teeth and bunged the barrel with the water the performance might be set down as a little out of the ordinary. If he had pulled the barrel out of the bunghole and watered the plug with his teeth, then indeed the incident might be worthy of a paragraph. If

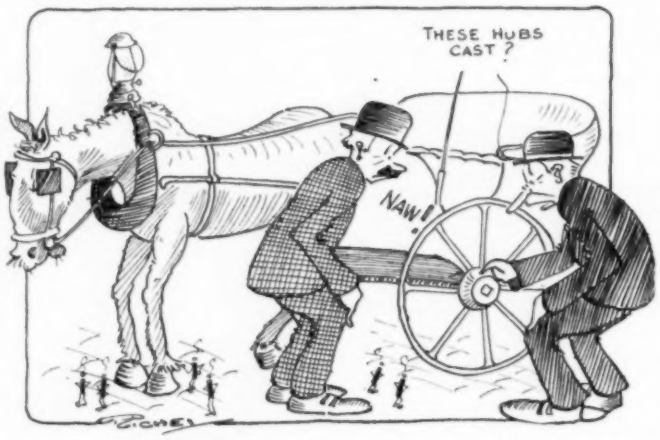


THE EXPERT RUNS A QUICK VISCOUS TEST

the horse had pulled his teeth out of the water and barreled the plug with the bunghole, or, if he had slaked his barrel with the plug and barreled the bung with his teeth, then the anecdote might be worthy of a place in the *Annals of Our Humble Friends.*

Continuing in the same strain and warming up to the subject, the writer pointed out that if the plug had pulled the horse out of the bunghole and slaked his teeth with the barrel, or if the barrel had plugged the horse with the water, or bunged him with a good, swift thirst, he could see some reason for giving the item space in the farm papers.

He concluded by the statement that other combinations worthy of a really intelligent horse probably would occur to me readily. For example, he wondered if I thought it possible for a barrel to bung a horse in the teeth or to plug his slake with the thirst. In a postscript he wrote that he would leave one last consoling thought with me. If he ever learned that a thirsty bunghole drank the horse and then plugged him in the barrel with his teeth, he would write me without delay and send the precious news by air mail. Speed is this lad's middle name. He may be idle, but assuredly he is not lazy.



HEAD LIGHTS AND IGNITION SYSTEM ARE O. K.

My knowledge of horses, at least of the species that goes snooping around sucking water through all the bungholes in the neighborhood, is decidedly elementary. I have had some slight experience with clothes horses, animate and inanimate. I'll never forget one memorable and back breaking day I spent in the company of a saw horse, a pile of hard, knotty railroad ties and a brawny negro *vis-a-vis* at the opposite end of a crosscut saw. I have had some dealings with the familiar pairs of horses found in the foundry, but, as said, my knowledge of the horse, as an animal is rather sketchy. What little I have, has been derived from the printed page and from hearsay, instead of—er—personal contact and familiarity.

As a result of this desert spot in my field of knowledge, I decided to submit the letter to Bill before taking any action. In his younger days Bill rather prided himself on his ability to go into a livery stable and pick out a livery skate for an afternoon's whirl in a top buggy.

"Well," said the oracle, "I'll tell you. You know that old proverb: 'What's one man's meat, is just poison ivy to another.' With slight revision that proverb fits this case. We safely may assume that George derived a certain amount of pleasure in writing that thing. Otherwise he would not have wasted the golden minutes, each set with 60 diamond seconds, gone, never to return, in setting it down.

"You wasted part of your treasure of time in reading it and I'll not deny that I cheerfully threw away some of my own precious hoard of time in listening to you read it. However, I am afraid if the document were to fall into the hands of one of these life is real, life is earnest and the dollar is its goal, boys, he would tear it into small pieces and claim that the guy who wasted his time writing it, should be poisoned. Ah! well, as some giddy old bird remarked once upon a time, it takes all kind of people to make a world. I'd like to poison some of them, myself.

"Talking about curious compositions," he continued. "I got one the other day from a lad who assured me solemnly that it is an exact copy of a report turned in, or rather prepared—it never was turned in—by a prohibition officer in this lad's home town.

"This gallant upholder of law and order, this uncompromising foe of the demon Rum, was sent to investigate a place where it was claimed the cursed beverage was displayed for sale in stealthy, but nevertheless earnest defiance of a noble statute duly made and provided for the extinction of the nefarious traffic.

"When he failed to return in a reasonable time, a searching party, properly armed and equipped, was sent out to locate him."

"Who cared whether he was lost or not?" I inquired, curiously.

"A fair and proper question," Bill admitted, handsomely. "Several people cared. I am afraid some of them hoped he was lost, permanently. A few of his confreres did not share this heartless view and, as I say, they started an investigation.

"They found him sprawled on the floor, fast asleep with an empty bottle clutched fast to his breast. A dozen bottles, also empty, were on a table, some upright and others reposing gracefully on their sides. A typewriter with a sheet of paper almost completely covered with writing sat near one edge of the table and bore mute evidence to the hero's devotion to duty. The leader of the party snatched the sheet of paper out of the machine and read the following truthful and accurate account of how the gallant officer had met—and vanquished—the enemy:"

April 1, 1929—Findings in reported violation of Eighteenth Amendment to the Constitution at premises No. 1827 Brightside Street, City. Arrived at said premises 9:30 p. m. Found door locked and knocked on same. Loud talk and raucous laughter inside indicated large party indulging in unseemly hilarity. In response to second knock, peep hole in door opened, followed immediately by cessation of all sound. Further knocking ineffectual. Crawled through window and found place deserted as if in great hurry. Found twelve (12) bottle, receptacles, or glass containers on tables. Labels on these bottles, receptacles or glass containers led me to believe contents of same were of an intoxicating nature and therefore were subject to confiscation as evidence under the provision of the Act.

Former experience warned me to expect a plant, a deliberate attempt to lead the department astray and thus expose it to ridicule. Proceeded to investigate contents of first bottle by subjecting same to test of three senses, sight, smell and taste.

Sat in chair, placed bottle firmly between knees, extracted corkscrew from right hand hip pocket, inserted corkscrew in cork, removed same and spilled small portion of liquor in hand. Sight and smell test satisfied your investigator liquor corresponded with legend on label. Judgment confirmed by small slug swallowed experimentally. Spilled remainder down drain pipe. Returned corkscrew to right hand hip pocket and started to write this report.

Stopped at this point to make assurance doubly sure. Selected second bottle at random and placed firmly between knees as before. Reached into hip hip right hand for pocket and inserted same in cork and pulled neck out of cork. Applied same careful tests as careful tests, you know me kid, taste all right to me, just two or three swallows make summer, spilled remainder of neck down waste pipe.

Just as well make thor*thur*

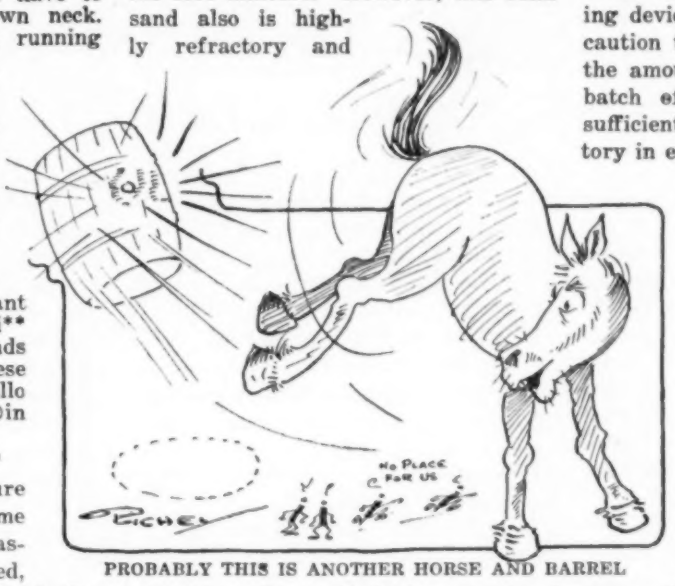
thouroughо vestigation. Placed third bottle firmly in hip pocket. Gripped same firmly with corkscrew Inserted right bottle in neck and pulled Johhny Walker out of cork. Smell o. k. visibility low, taste fair, but nothing to write home bout for honor of service much against will had to taste three 3 3 3 times make sure (!%$ very strange so;e one pinched dra*n p8pe here minute ago have to shpill rest of corkscrew down neck. Ver# heavy sea 4′ nngng running harbor bar moaning and one bright star for me wh$n i put put put out to sheshaw mar-Jory daW* good ol scout Tennson sure knows his STUFF hot stuff ol/ ten idal King fins mishef still @$%!—*/-# Beg to a "vise impossble possable contin7e repor5 table at dengeresh angle Skitch bottles dancing highland fling cant ketch one qwertyuiop #-/*ri** hand! pockit lost all hands inser5 corkskrw between knese pull nak out of cork swallo drahn pip# bgre%*m@in yeure rooley

*Gyh- ZZZXnm,**

"There is only one feature about the thing that causes me to view it with a slight measure of doubt," Bill remarked, "and that is the date of the beginning of the officers report.

"However, while we are on the subject of letters and liquor I am reminded that I had a letter recently from a foreign foundryman who was not quite satisfied with the core oil he was using. He wrote that for some time he had been experimenting with different core oils of European and American origin. The American core oil produces an excellent core, but he finds that it has one objectionable feature. The sand sticks in patches on the face of the casting. He forwarded a small sample cut from a casting for my observation and said he would appreciate advice on how to prevent this form of trouble.

"From the sand patches on the small sample of casting submitted I was at a loss to determine whether they were caused by scabbing or erosion. Only an examination of the position of the core in relation to the gates could clear up that point. If the casting did not show any of these defective patches except in the immediate vicinity of the gates, then, apparently the cause of the trouble may be laid to erosion. The sand is not strong enough or refractory enough to withstand successfully, the first rush of the metal. Addition of clay or burned sand to the core mixture increases the tendency to crumble and fuse when exposed to a moving stream of iron. For that reason the universal custom in American foundries engaged in the production of castings for the automobile industry is to use a high grade, clear silica sand bonded with oil. On bulky cores, difficult to hold in shape in the green state, also cores in which the highest permeability is not essential, a small quantity of bank sand is added to the core mixture. However, this bank sand also is highly refractory and contains only a limited amount of bonding material.



PROBABLY THIS IS ANOTHER HORSE AND BARREL

"Assuming that the foregoing points are familiar and have been taken into consideration, also that the patches of sand appear at points on the casting, not subject to the wash of the metal, then the obvious conclusion is that the patches are scabs caused by lack of permeability in the core. The most probable cause of the trouble is an excessive amount of oil in the sand. Plenty of oil produces a hard, firm core, easy to handle and one that reflects great credit on the core making department, in that the breakage loss is held to an exceedingly low figure. The effect of these hard cores is not so good in the foundry. Excess oil closes the interstices, reduces the porosity or permeability of the sand and at the same time increases the volume of gas which has to escape when the mold is filled with molten metal. In a tight, hard core, some of this gas is forced through the skin and in its passage some of the sand near the surface is loosed and washed away. The rough areas on the casting are not composed of sand sticking to the casting. They are iron that has taken the place of patches of sand that floated away. If he were to break the entire casting into small pieces, he would find these patches of sand landed here and there. Without breaking the casting, these patches of sand manifest themselves in defective areas of castings exposed to a pressure test, either water or air.

"I suggested for a start that he cut down on the amount of core oil used for bonding the sand. Cut down as far as possible, or if feasible, eliminate altogether from the mixture any molding sand with its high bond. Install an automatic measuring device, or take other suitable precaution to insure positive control over the amount of core oil added to each batch of sand. If the sand is not sufficiently refractory, but is satisfactory in every other way, he can prevent the face from fusing by dipping the small cores in blacking, or by brushing or spraying the larger cores with the same material. Insufficient drying sometimes causes a rough, scabby, fused face on a cored casting. The ideal core is dried almost to the point of scorching. All the volatile matter is driven out and the sand grains are held together by the thinnest kind of a film. Every prominent American core oil manufacturer maintains a research department and if a foundryman writes to the particular firm identified with the oil he is using, explicit directions, hints and advice will be forwarded."

Hold Simplified Practice Conference

Division of simplified practice, bureau of standards, U. S. department of commerce, held a general conference on the simplification of wheelbarrows for all elements of the industry for the consideration of a proposed program. P. H. H. Dunn, division of simplified practice, bureau of standards, arranged the conference which was held at the department of commerce, Washington, D. C., April 26. Copies of the simplification may be secured upon request from Mr. Dunn, division of simplified practice, Department of Commerce building.

Elected Vice President

E. P. Boyer, vice president of the Milburn Sales Corp., and the Milburn Paint Spray Corp., Philadelphia, has been elected vice president of the Alexander Milburn Co., Baltimore. Mr. Boyer became associated with the company in 1919 as Philadelphia district manager. In May 1926 he established the Milburn Sales Corp., and in 1928 was elected vice president of that company and also of the Milburn Paint Spray Corp.

Introduction of
Oil-fired Furnaces
Made Changes in Brass Melting

By Edward L. Wolff and R. C. Jeter

MELTING of brass in oil-fired furnaces is the story of the transition of brass casting from a highly specialized art, whose secrets were jealously guarded by the members of that craft, and passed down from father to son, or to some other favored individual, to a systematized and scientifically controlled industrial process, adapted to large scale production, manned by ordinary laborers.

From the time of the inception of the Scovill Mfg. Co., Waterbury, Conn., in 1802, the entire development of the factory system of industry occurred. We all know of the great strides made by American industry in its various processes, and the fabrication and manufacture of brass was no exception to the rule. However, in the casting of brass since the period when the first skilled brass workers were brought to this country, after being smuggled out of England, hidden in hogsheads, methods and equipment for melting brass changed but little, if at all, until the second decade of the twentieth century.

Followed Old Methods

Melting still was done in brick-lined, coal-fired pit furnaces, in crucibles small enough to be handled by one man with tongs and a rope. Stirring of the molten metal was done by hand with an iron bar. Pouring temperatures were judged by the color and behavior of the surface of metal in the crucibles, and by the intensity of the *kick*, or vibration of the stirring bar when plunged into the molten mass.

Casting was controlled by the exclusive guild of brass casters who worked as sub-contractors; hiring, firing and paying their helpers, weighing their own mixtures, and casting brass at a certain price per unit of weight. It is true that some of these brass casters were highly skilled craftsmen, and at times produced brass of a quality not excelled by more modern methods, but the whole process of casting daily was subject to the chance of human error, and the quality of a day's output depended upon the individual ability of many workmen, with no assurance that the next day's production would be of comparable quality.

The chief recognized disadvantages of the coal-fired pit furnace were:

Trace Transition

THIS article is abstracted from a paper presented at a conference on industrial oil and pulverized coal which recently was held at Yale university, New Haven, Conn. Mr. Wolff and Mr. Jeter are associated with the Scovill Mfg. Co., Waterbury, Conn., and in this article describe the transition from coal-fired brass melting furnaces to the electric furnaces and some of the results obtained from oil-fired furnaces.

The highly skilled personnel required and the high rate of pay enjoyed by casters; high metal losses; small units melted, and difficulty of applying modern scientific methods of control to the independent casters and to the quality of the product which they produced.

About 1909 the management of Scovill Mfg. Co. decided the time had come to attempt to bring the casting of brass into line with progress made in other divisions of the brass industry, and several experimental furnaces were built using oil, producer gas, and coke, as fuels. While the degree of success achieved with any of these furnaces was small, there was enough promise in the results to strengthen the conviction that the time had come for a drastic change in melting methods and that such a change was feasible.

Therefore, in 1909-1910, a program of research and development was planned and initiated that lasted in its experimental phase until 1914. The ultimate success of this venture may be attributed in large measure to the unfailing optimism, confidence, and persistence of those in charge through periods of discouraging lack of success, and at times when the obstacles and opposition seemed insurmountable.

Among the first experimental furnaces was a round pit furnace, holding a 200-pound charge in a crucible, heated by a spiral oil flame. Results obtained with oil showed an increased efficiency over coal. This same furnace was used with producer gas but results were less successful than with oil. Several years later a larger furnace, built to use fuel oil, was modified in design and run with producer gas and coke as fuels. Results indicated that in times of emergency, if the supply of hard coal or fuel oil was cut off, either of these fuels could be used.

Fired by Oil

All of the earlier tests indicated that oil was desirable fuel, due to its ease of control, efficiency and better working conditions for the men operating the furnaces. Extensive tests were made with various types of oil burners, various oil and air pressures, different sizes and shapes of flues and combustion chambers. From the data obtained a furnace of the following general description was designed.

The furnace was fuel-oil fired, tilting on trunnions set nearly in line with the pouring spout and contained a crucible holding 670 pounds of brass. Heat was supplied by a low pressure oil flame introduced through a flue one side of and below the bottom of the crucible. The oil flame spiraled upward around the crucible and around a crucible-mixture, cylindrical cap that rested on top of the crucible. Products of combustion left the furnace through a flue in the side of the furnace top, and entered the main flues leading

to the smokestacks. The upper part of the furnace consisted of a removable top enclosing the crucible cap. The crucible cap held part of the charge, pre-heated it and fed it down into the crucible as the charge in the crucible melted. The burner consisted of a lip over which the oil was blown by a 2½-pound air jet, into a blast of combustion air from a 2⅛-inch diameter orifice under a pressure of 3½ ounces. At first, the combustion air was preheated by the exhaust flame but this practice soon was abandoned.

The earlier furnaces were lined with special fire brick, but the bricks were replaced by a rammed-in lining of a carborundum mixture. The average life of the latter linings was about 900 heats.

Furnaces were expected to average 8.6 heats a day each. During the first year of operation they averaged 8.2 heats in 24 hours, and this speed gradually increased until 1921, when the average for the year was 19.66 heats a day.

During the years the oil furnaces were in service, the operating personnel made steady improvement in methods of operation, and the furnaces underwent modifications and refinements in design, as is demonstrated by the 140 per cent increase in the daily average production per furnace in the space of five years. The greatest single change in design was to a great extent forced by the shortage of material for making crucibles. The crucible-mixture, cylindrical cap, that fitted into the top of the furnace, and protected the charge from contact with the flame, was eliminated, and a furnace top was designed that permitted the flame to come into intimate contact with the charge. This change was fought by some of the best engineers because of their belief that zinc losses would be greatly increased. Experience proved that the volatization losses *per unit of time* were increased, but the *total* melting time was decreased to such an extent that the net metal loss remained constant. On a number of occasions the metal melted in one furnace ran as high as 27 heats in 24 hours. The average heats per day previously quoted included time shutdown for repairs, replacing and preheating crucibles and relining furnaces.

The tonnage of brass melted in the oil furnaces was 118,000,000 pounds in 1916; 171,000,000 pounds in 1917; 184,000,000 pounds in 1918. From the end of 1918 until 1922, the oil furnace production gradually tapered off due to the after-the-war lull in business and the gradual replacement of oil by the electric furnaces. Altogether, about three-quarters of a billion pounds of various nonferrous alloys were melted, the value as cast of which was approximately $141,000,000.

The overall cost of melting in the oil furnaces was about half-way between the cost of operating the coal-fired, pit furnaces and the induction electric furnaces. Metal losses in the furnaces favored oil over coal to about the same extent that the electric furnaces have reduced oil furnace losses.

When the induction electric furnaces arrived it was found that the buildings, mold equipment, handling facilities, etc. were ideally suited to them. It was necessary only to remove the oil furnace shells from their trunnion rings and slip the electric furnace shells into their places. Even the galleries under the oil furnaces into which worn out linings and crucibles were dropped, were found perfectly located and adequate in size to house the electrical switching equipment and step-down transformers necessary to feed the induction furnaces. Fans and air lines which supplied the oil burners with combustion air are now cooling the primary coils in the electric furnaces. The organization recruited and trained to operate the oil furnaces took over the electric furnaces without having to change their habits and practices to any degree. One line of fourteen oil furnaces is still standing-by ready to carry on over a peak of production or to take up part of the load in case of a major electrical breakdown.

Book Review

Metal Crafts in Architecture, by Gerald K. Geerlings, cloth, 202 pages, 8½ x 11½ inches, published by Charles Scribner's Sons, New York, and supplied by THE FOUNDRY, Cleveland, for $7.50 plus 15 cents postage, and in London by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster, for 37s 6d.

While a number of books have been published on decorative metals used in architecture, they generally relate to only one metal and the subject is treated from a general historical viewpoint. However, this new volume is distinct from those mentioned in that it gives a parallel presentation of the outstanding characteristics of the metals used in decoration, and treats with the metals from an architectural standpoint.

Since bronze has been used probably more than any other for embellishment, more space is devoted to it. This section is followed by those on brass, cast iron, copper and lead. A short, concise history of each metal is given and this is followed by a description of the craftsmanship employed in producing the finished piece such as casting, etc. Numerous illustrations of old and modern applications show the extensive use and decorative beauty of the various metals. The book also describes lighting fixtures, enameling, deposition of metals on glass, electroplating, etc. The author closes with a short section on specifications which will be of interest both to the architect and to the manufacturer of this type of craftsmanship.

Applies Emergency Face To Disk Sander

By W. B. Kresge

Do you remember when the sand paper on your sand disc was worn out and needed changing? You had a hurry up job which had to go out in a certain time and to your surprise you found the apprentice boy had forgotten to cement a new wafer on the extra disc. You felt like bawling him out until you just happened to think you intended to order a gallon or two of cement last week and forgot to do so and the boy was not to blame after all. It is a common experience. Don't be alarmed next time it happens. Clean up one of the extra discs as if you were going to use the old cement. Place the disk on the machine without any paper. Start the machine and apply a coat of belt dressing by holding the stick in your hand and applying it to the surface of the disk while the machine is in motion. This will cause the dressing to become warm and sticky. Stop the machine. Apply the sand paper wafer to the disk with the palm of your hand or tamp it with a soft wooden block and you will find the machine is ready for use.

Establishes Warehouse

Cutler-Hammer Inc., Milwaukee, Wis., has established a warehouse at Cleveland with 1600 square feet of floor space. It is stocked with a complete line of standard motor control equipment and wiring devices. The new warehouse will serve the central sales district of the company composed of Ohio, West Virginia, Pennsylvania, province of Ontario, Canada, western New York and sections of Maryland, Indiana, Tennessee and Kentucky. Sales offices for the district are located at Cleveland, Cincinnati, Buffalo and Pittsburgh.

Readers Comment

Note—Material appearing under this head does not necessarily reflect the opinion of THE FOUNDRY or of its editors.

TO THE EDITORS:

I was greatly interested in the editorial published in a recent issue relative to trade practice conferences and to the digest given in a later issue on opinions received in response to the editorial. Sentiment seems to indicate that you are on the right track in your endeavor to arouse the foundry industry into establishing itself on just as firm a basis of doing business uniformly in an ethical way, as have many other branches of industry not nearly so large or of such major importance. The question appears to be what procedure shall be taken to most effectually cover the entire industry.

My opinion coincides with several already expressed: The foundry industry is so large and extensive that it might prove too unwieldly to handle the problem at the present time. Better results probably would be obtained if the Gray Iron institute, the Malleable Iron Research institute, the Steel Founders' society and a body from the nonferrous branch would undertake the preliminary work for their respective branches. Careful study and consideration by each group, reporting to a general conference should serve to indicate the proper steps to follow.

I believe the steel casting executive who says that the foundry industry needs to make a careful analysis of what actually transpires during that period between the broadcasting of the inquiries for prices and the final placing of orders. Having a list of most of the movements and actions in that period, a list of fair, ethical and businesslike practices may be prescribed in detail. Likewise, a list of the unfair and uneconomic practices may be made. This analysis will cover only that phase of competition resulting from inquiries. It can be extended to the solicitation of new customers and it should probably cover every phase of competitive practices. Even though the industry should have a trade practice conference under the auspices of the federal trade commission, I think it will be necessary first to make the above study to obtain the facts and prepare the recommendations to be submitted to such a conference; expressed in a very concise way, the action necessary to bring results. I also feel sure the answer to your question "Might not such a study of the entire field of castings manufacture and sale be valuable to the industry?" can be nothing but an emphatic yes.

If such a study is made, would not a similar study covering the patternmaking branch of the industry prove valuable? Adoption of trade practice rules by the foundry industry may prove the forerunner of a code for the patternmaking branch. Of course I have the jobbing end of the business particularly in mind. Regardless of the above, I believe the adoption of a trade practice code by the foundry industry should contain a clause or statement which would correct the existing bad practice prevalent among some foundries regarding the quotations on and charges made for pattern equipment.

Perhaps I should have prefaced my remarks by stating that I have been associated with the industry for 20 years, am a graduate of technical foundry courses at Wentworth institute, Boston. Also have had considerable practical foundry experience, although most of my time has been devoted to the patternmaking branch of the industry. At present I am connected with the Niagara Pattern Works, Niagara Falls, N. Y., in a semiexecutive capacity.

I look forward, with interest, to reports of progress made and am hopeful that the effort will prove successful, thus placing the foundry industry on a much firmer footing.

ANDREW C. HOAK.

1833 Cleveland Ave.,
Niagara Falls, N. Y.

Does Not Agree

TO THE EDITORS:

I just have finished reading the article by Victor E. Hillman which appeared in the April 15 issue of THE FOUNDRY, and am surprised to see an article of this kind published, especially when you consider that THE FOUNDRY is recognized as a medium for transmitting information to young executives as well as prospective executives.

Mr. Hillman states that the real objector to his article would be the man who never solved a problem except on paper. I have solved a great many foundry problems to the satisfaction of stockholders of a number of different foundries but still I object strenuously to Mr. Hillman's remarks. I have neither the time nor inclination to debate the many peculiar notions which he has evolved. I can prove, however, that analytical procedure has removed shrinkage flaws, by reducing the phosphorus from about 0.60 per cent to 0.20 per cent. This was worked out many years ago at the Ferro Machine & Foundry Co., Cleveland, and practically eliminated shrinkage in cylinder castings. In some cases this trouble accounted for 30 per cent loss. It is true as Mr. Hillman says that you cannot correct the mixture in the cupola before pouring, but you can correct the mixture in the next heat.

I have had experience in making loom castings in a jobbing shop and we always considered them next to sash weights in simplicity. Mr. Hillman says that foundrymen indulge in too many platitudes. I believe that you will agree with me that the last paragraph in his article is the epitome of platitudes. I always have maintained that the foundryman who has the knowledge on which to base worthwhile articles, often is too busy to write them. I believe that Mr. Hillman's article confirms this contention.

E. S. COHEN,

Stoney Foundry Engineering & Equipment Co., Cleveland.

Revise and Refigure

TO THE EDITORS:

I noticed an editorial in a recent issue of THE FOUNDRY entitled "Revise and Refigure." I wish that every foundryman responsible for sales would commit your editorial to heart, or perhaps it would be better for executives to do so, for certainly you have placed your finger on the most vicious of all failings of our industry.

W. H. WORRILOW,
President.

Lebanon Steel Foundry,
Lebanon, Pa.

Note: The phase of the matter of selling covered in the editorial mentioned, was dealt with in an able manner by Mr. Worrilow at a breakfast meeting of the National Founders asassociation. THE FOUNDRY merely gave circulation to the profound belief of those in the industry who know of the importance of the problem.—THE EDITORS.

Opens New Plant

Prest-O-Lite Co., Inc., 30 East Forty-second street, New York, has established the thirty-ninth acetylene gas plant of its chain at 925 Hughes street, Houston, Tex. The new plant started operations Feb. 2. A. J. Harrower is in charge of the establishment and H. F. Sautter, Dallas, Tex., is the district superintendent.

What Others Are Thinking

Abstracts Selected from the World's Foundry Literature

Repairs Marine Castings

A method for Molding Heavy Castings Without Patterns, by Fernand Gillis. *La Revue de Fonderie Moderne*, Paris, Dec. 25, 1928.

In this, the fourth of a series of articles, the author studies castings made in harbors where marine machinery is repaired and spare parts made. In most cases the original pattern of the casting is not available, and there is not sufficient time to make a pattern. The author chooses for his example the repair of a pump weighing about five tons, on which a part must be replaced. The old part serves as a pattern, but cores have to be made and an extra thickness added to allow for contraction. The part will be cast in loam, and the article describes the preparation of the mold. The making and the placing of the cores are particularly delicate operations. Illustrations show how the cores are placed, and their order.

Presents Annealing Results

Annealing of Cast Iron, by H. H. Beeny, *Foundry Trade Journal*, London, March 28 and April 4, 1929.

The author carried out an extensive investigation on the effect of annealing cast irons of various analyses and cast under different conditions. Conclusions drawn are as follows:

(1) At annealing temperatures immediately below 800 degrees Cent. (1472 degrees Fahr.) the pearlitic carbide is unstable and its destruction is merely a matter of time, but is more rapid, the higher the silicon in the iron.

(2) Massive carbide as found in chilled metal requires approximately 850 degrees Cent. (1562 degrees Fahr.) to break it down completely in a 2 to 3-hour period. Temperatures below 800 degrees Cent. are quite useless to accomplish this, even with the silicon over 3.0 per cent. Metal containing 1.11 per cent silicon with 0.152 per cent sulphur required 950 degrees Cent. (1742 degrees Fahr.) for 6 hours. This is exceptional and 850 degrees Cent. (1562 degrees Fahr) will suffice for all but the most obdurate irons.

(3) In general, the pearlitic carbon is stable at a temperature of over approximately 800 degrees Cent. and complete annealing cannot be accomplished in this range of temperature alone. The statement must be qualified in that the higher the silicon, the less combined carbon is retained until with a silicon of 3.0 per cent, it becomes almost completely unstable. In medium and low-silicon irons reheating above 800 degrees Cent. will reform a portion of the carbide, even if previously completely decomposed, by annealing into iron plus graphite.

(4) Amount of carbide remaining stable or reformed increases with temperature from 800 up to at least 950 degrees Cent. (1472 to 1742 degrees Fahr.).

(5) The decomposition of carbide is rapid in the range below 800 degrees Cent. so that the amount of carbide in the cold metal depends upon the rate of cooling through that range. Thus, iron cooled in air blast retains considerably more carbide than if it is cooled in still air.

(6) Pearlitic carbon has a definitely beneficial action on the transverse and tensile strength of cast iron. In general, the lower the silicon the greater the amount of combined carbon in the iron when cast and stronger the metal, but when annealed, the greater in consequence is the loss of strength. It follows that high silicon irons are in general, weak, and that they are but little affected in strength by any annealing treatment. The removal of combined carbon tends to reduce the strength of all irons to approximately the same low value. The general opinion that a completely pearlitic matrix gives the greatest strength is supported.

(7) Machinability is increased by loss of combined carbon. To obtain maximum machinability, castings should be annealed first at 850 degrees Cent. (1562 degrees Fahr.) to remove possible chill and equalize the combined carbon in all parts and then (actually or by slow cooling) be maintained below 800 degrees Cent. (1472 degrees Fahr.) to remove all combined carbon. This gives the minimum brinell hardness.

(8) There is little doubt that in general the wearing quality is reduced with the combined carbon. This and strength considerations show that the *indiscriminate annealing* of gray iron castings is thoroughly bad.

(9) When all combined carbon has been removed by full annealing it is found that the brinell hardness (minimum for any one iron) increases proportionately with the silicon content.

(10) Brinell hardness increases with the combined carbon in any one metal but the hardening action of silicon is so marked that the brinell hardness gives no idea of the combined carbon, irrespective of grade of metal, nor does it give the slightest indication of tensile or transverse strength.

(11) Supporting the generally accepted opinion, the tensile and transverse figures using machined bars show a constant relationship independent of composition, or whether chill or sand cast, annealed or unannealed. In general, the ratio of modulus of elasticity to tensile strength lies between 2.0 and 2.2 for machined transverse test bars.

(12) Striking increases in strength with annealed chilled cast bars were obtained when the composition was such that deep chill formation was avoided. This makes for soundness and the interior metal possesses a much finer form of graphite than that obtained by the annealing of completely white metal.

Melting and Casting Monel Metal

Monel Metal: Some Notes on Melting and Casting, by W. McCulloch, *Metal Industry*, London, March 29, 1929.

Melting point of monel metal is given as 1360 degrees Cent. (2480 degrees Fahr.), and the pouring temperature 1500 degrees Cent. (2732 degrees Fahr.). The molten metal absorbs carbon and sulphur readily from the furnace atmosphere, and care must be taken to prevent contamination. Graphite crucibles and brick-lined electric arc furnaces work satisfactorily. Melting time in the pit furnace with a 250-pound charge is two hours. The empty crucible is brought to a red heat and then lifted out while a new bottom of coke put into the furnace. The crucible is replaced and coke charged around the sides. One-half pound of manganese ore then is placed in the bottom of the crucible to keep out carbon and form a good slag. The small scrap is placed immediately on top of the manganese ore and then the ingots are placed crosswise on the top of the crucible. The whole charge of metal is inserted at one time and is so placed that no coke can get into the crucible. The furnace is then filled to the throat and the fuel allowed to burn down. Next the crucible is eased up and a new bottom put into the furnace. The furnace again is charged to the throat and allowed to burn down. This last charge should bring down the metal for pouring. It is important to perform all operations mentioned rapidly.

When the metal reaches 1500 degrees Cent. (2732 degrees Fahr.) 2 pounds of ferrosilicon is added 5 minutes before withdrawing the crucible from the furnace. The metal is stirred well to make sure the silicon is melted. Before pouring further deoxidation is necessary and this is accomplished by adding 2 ounces of magnesium just before drawing the metal from the furnace and 3 ounces immediately after removing from the furnace. Then the metal should be skimmed free from slag.

Molding for monel metal follows both steel and brass foundry practice. Methods of gating and risering follow steel while molding and ramming follow that in nonferrous practice; shrinkage is ¼-inch per foot. Cores must be collapsible to allow free contraction of the metal.

The Shakeout

DAN M. AVEY, Editor
PAT DWYER, Engineering Editor
EDWIN BREMER, Metallurgical Editor
FRANK G. STEINEBACH, Managing Editor
CHARLES VICKERS, Nonferrous Editor
NORMAN F. HINDLE, Assistant Editor

¶ Foundrymen of the World

WHILE the nations of the world are discussing world peace, limitation of armaments and other problems leading to the abolition of war, leaders in one of the basic industries of present day civilization are moving in a definite direction toward the realization of international understanding. For the third time in six years, foundrymen of the world are gathering to become better acquainted, to discuss the many problems of the industry, to view the developments that have been made in equipment and supplies so essential to present day progress and to visit plants which are pointing the way to better practice.

For a number of years, the leading foundry associations of the world have been exchanging technical papers bearing on important phases of the various ramifications of the foundry industry. The authors of these papers, authorities in their particular line of endeavor, have given freely from their storehouse of knowledge, that the industry as a whole may grow in importance.

FIRST International Foundrymen's congress, an outgrowth of the exchange paper idea, was held in Paris, France, in 1923, with American foundrymen well represented. In 1926, the American Foundrymen's association had the honor of entertaining the largest and most distinguished group of European foundrymen ever to visit the United States, when the second congress was held in Detroit.

Today, a large group of Americans is bound for London, bearing a message of good will and cooperation to the third International Foundrymen's congress which opens in the world's largest city on June 11. The program which has been arranged by the Foundrymen's International committee, the Institute of British Foundrymen, and associations on the Continent, is of such a high character that great achievements cannot help but follow.

THE American foundry industry is proud of its part in this International movement, and pledges its continued full support to the improvement of world foundry practice.

¶ Survey Steel Capacity

ACCORDING to statistics issued April 24, 1929 by the American Iron and Steel institute, the steel castings capacity of the United States shows a slight decrease since the last estimate was made. J. F. Froggett writing in *Daily Metal Trade* observes that the total steel castings capacity of the country now is given as 2,024,923 gross tons, a loss of 4411 tons or 2.1 per cent compared with the estimated capacity of Dec. 31, 1927.

The following table gives in brief form the comparison of steel castings capacity as of December, 1927 and April, 1929:

AMERICAN IRON AND STEEL INSTITUTE
Estimated Steel Castings Capacity

	Dec. 1927	April 1929	Percentage Gain	Percentage Loss
Total	2,029,334	2,024,923	.....	2.1
Basic Open Hearth	776,727	780,175	0.44	.....
Acid Open Hearth	712,385	693,715	.....	2.6
Bessemer	66,383	49,188	.....	25.9
Electric	471,404	499,450	5.9	.....
Crucible	2,435	2,395	.....	1.6

IT IS significant to note that electric steel castings capacity shows an increase of 5.9 per cent, the largest advance of any of the classifications. Basic, open-hearth capacity also was increased, but in smaller amount. The trend toward electric furnace practice in steel castings manufacture has been pronounced and is reflected in the capacity figures given by the institute.

¶ Broadcasting Safety

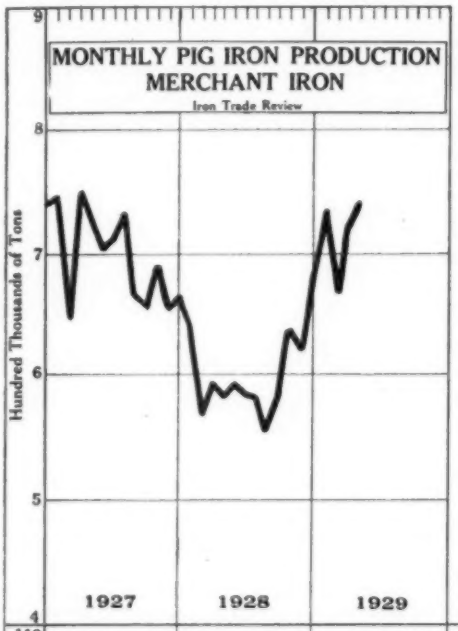
AIDED by important industrial men, civic leaders and public officials, the National Safety council has undertaken a campaign for safety which will reach the majority of homes in the country. Over a period of three months, a talk on some phase of the safety movement will be broadcast each Saturday evening over a nation wide hookup arranged by the National Broadcasting Co. Radio listeners will find it well worth while to tune in on these programs every Saturday night at 7:15 p. m., eastern standard time.

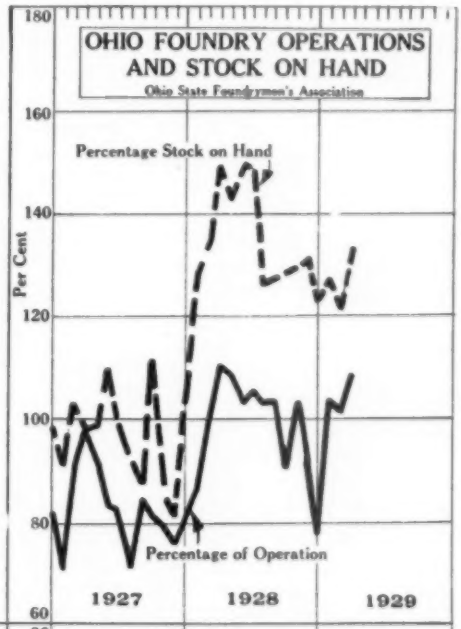
Trade Trends in Tabloid

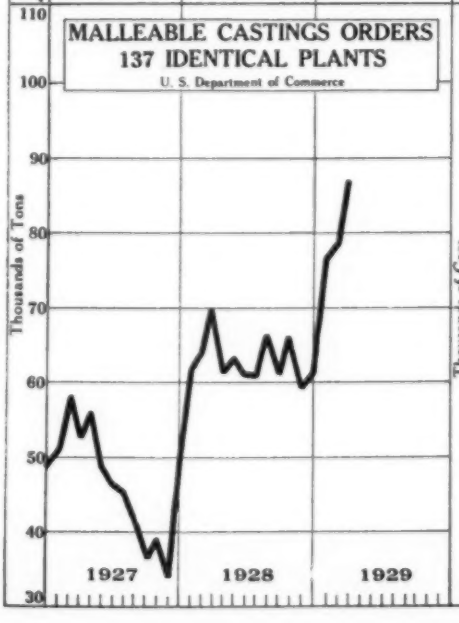
OPERATING rates in foundries continue at a high average. Automotive shops are working at capacity and many manufacturers operating their own foundries are contracting work with jobbing interests. Railway car orders for April fell behind March, but early inquiries indicate that May again will show an advance in car buying. Car loadings for the week of April 20 were in excess of a million for the first time in 1929. Building construction awards are running slightly behind last year, when the total is considered, but permits for industrial types are above the average for 1928. Steel casting orders are the highest they have been for the past five years. The orders for March represented 89 per cent of capacity, compared with 57 per cent of capacity in March, 1928. Pig iron production for April constituted a record with a daily average of 122,106 gross tons, according to *Iron Trade Review*. The total output was 3,663,167. The March production, with its extra day, totaled 3,709,518 tons. Merchant iron for April totaled 586,045 tons. Average nonferrous prices, according to New York quotations in *Daily Metal Trade* follow: Casting copper, 19.50c; electrolytic copper, 19.817c; Straits tin, 45.880c; lead, 7.186c; antimony, 9.50c; aluminum, 23.90c; Zinc averaged 6.670c, E. St. Louis, Ill. Brass foundry operations are satisfactory.

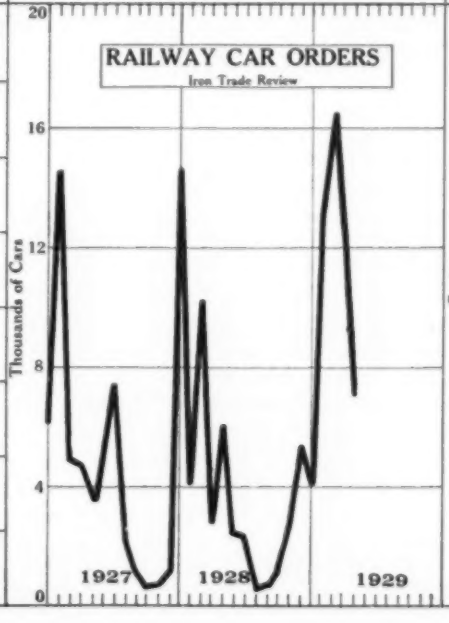
RAW MATERIAL PRICES
May 7, 1929

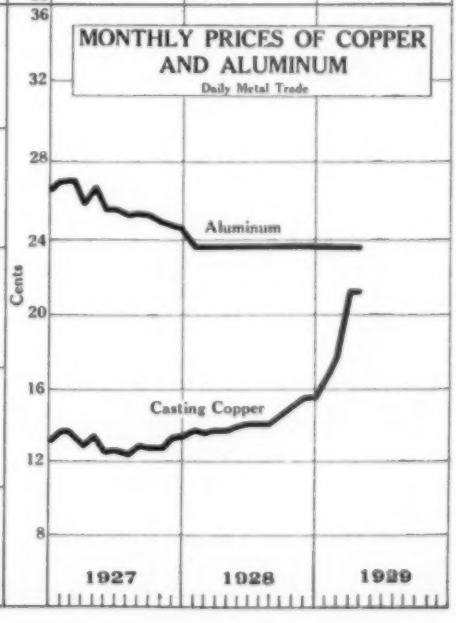
Iron	
No. 2 foundry, Valley	$18.50
No. 2 southern, Birmingham	15.00 to 15.50
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	22.26
No. 2 foundry, Buffalo	19.50
Basic, Valley	18.00 to 18.50
Basic, Buffalo	17.50
Malleable, Chicago	20.00
Malleable, Buffalo	20.00
Coke	
Connellsville foundry coke	$3.75 to 4.85
Wise county foundry coke	4.25 to 5.00
Scrap	
Heavy melting steel, Valley	$18.00 to 18.25
Heavy melting steel, Pitts	18.00 to 18.50
Heavy melting steel, Chicago	15.75 to 16.25
Stove plate Buffalo	13.50 to 13.75
Stove plate, Chicago	12.75 to 13.25
No. 1 cast, New York	13.00 to 13.50
No. 1 cast, Chicago	16.00 to 16.50
No. 1 cast, Philadelphia	16.00 to 17.00
No. 1 cast, Pittsburgh	15.00 to 16.00
No. 1 cast, Birmingham	15.00 to 16.00
Car wheels, iron, Pittsburgh	16.00 to 16.50
Car wheels, iron, Chicago	15.00 to 15.50
Railroad malleable, Chicago	19.00 to 19.50
Agricultural mal., Chicago	16.00 to 16.50
Malleable, Buffalo	19.00 to 20.00
Nonferrous Metals	Cents per pound
Casting, copper, refinery	17.62½
Electro, copper, producers	18.00
Straits tin	44.00
Lead, New York	7.00
Antimony, New York	9.00 to 9.12½
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	17.00 to 17.50
Zinc, East St. Louis, Ill.	6.60











Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

F. W. STOKES, director of the centrifugal casting process at the plant of the Stokes Casting Co., Mansfield, England, devotes some of his spare time to a more or less protracted excursion into the field of fiction writing. Some time ago a mystery story, "The Dalehouse Murder," written over the name of Francis Everton, attracted considerable attention. Recently a second story under the title of "The Hammer of Doom" by the same author and dealing to a considerable extent with foundries and foundry processes, aroused particular interest in gray iron foundry circles on account of the accurate and intimate knowledge of the subject displayed by the man who wrote the story. Speculation on the identity of the author has been set at rest by the announcement that Francis Everton is the pen name of Mr. Stokes. Incidentally the methods and equipment employed at the plant of the Stokes Casting Co. were described in the March 15, 1922, issue of THE FOUNDRY.

William C. Hedgcock, recently appointed chief mechanical engineer of American Steel Foundries, Chicago, was employed in the mechanical department of the Louisville & Nashville railroad at Louisville, Ky., from 1905 to 1911, when he became chief draftsman of the Chicago, Indianapolis & Louisville railroad at Lafayette, Ind. In 1912 he entered the employ of American Steel Foundries in the engineering department at Granite City, Ill., later being transferred to the Hammond, Ind., works, and was made mechanical engineer of brake department at Chicago in 1915. Mr. Hedgcock served from 1917 to 1919 as lieutenant and captain in the engineering division of the army ordnance department. Returning to American Steel Foundries in 1919 as mechanical engineer of brake department, he later was promoted to assistant chief mechanical engineer, which position he held until his recent appointment as chief mechanical engineer.

L. E. Thomas has been re-elected president of the Reading Iron Co., Reading, Pa. R. J. Wenger, formerly assistant to the president, has been elected a vice president. P. N. Guthrie, also vice president, and Mr. Wenger were elected members of the board of directors. Other officers of the company that were re-elected are John M. Callen, vice president; George W. Delany, secretary; Henry N. Yost, treasurer.

E. C. Hummell has been appointed manager of the foundry of the Otis Steel Co., Cleveland, to succeed J. J. Bever. Mr. Hummell has been identified with the company for several months. After an extended vacation, Mr. Bever will serve the company in an advisory capacity and by August will have completed 30 years' continuous service.

S. S. Little, formerly connected with the Walworth Co., Attala, Ala., the Warren Foundry & Pipe Co., Phillipsburg, N. J., and lately with the Fate-Root-Heath Co., Plymouth, O., as foundry superintendent, has accepted a position as assistant metallurgist of the Ohio Brass Co., Mansfield, O.

M. J. Carroll, formerly connected with the roll department, Hubbard Steel Foundry Co., East Chicago, Ind., and later with the Pettigrew Foundry Co., Harvey, Ill., recently became superintendent of the Michigan City Foundry & Machine Co., Michigan City, Ind.

W. C. Dickerman, formerly vice president of the American Car & Foundry Co., New York, has been elected president of the American Locomotive Co., succeeding William H. Woodin. Mr. Woodin will retain his position as chairman of the board of directors.

William K. Wayland, formerly general superintendent of the Wagner Malleable Iron Co., Decatur, Ill., has been appointed plant superintendent, Illinois Malleable Iron Co., Chicago.

Friedrich E. Gruetzmacher, formerly connected with the Buick Motor Co. in its foundry, has gone to Germany to take charge of the foundry of the Edmund Becker & Co., Leipzig.

G. G. Floyd has been made mechanical assistant to the president of the American Steel Foundries. He has been chief mechanical engineer at the Chicago office since 1912.

C. M. Carmichael, general manager of the Welland Steel Castings, Ltd., Welland, Ont., has been elected president of the Welland, Ont., board of trade.

Granville P. Rogers, whose appointment as director of the Steel Founders of America, Pittsburgh, recently was announced, will maintain offices in the Graybar building, New York.

David A. Crawford, vice president of Pullman Inc., has been elected president of the company succeeding the late Edward F. Carry.

Exhibition Tickets

Tickets for the International Foundry Trades Exhibition, to be held in Royal Agricultural Hall, London, England, are available at the London office of THE FOUNDRY, 416 *Caxton House, Westminster, S. W. 1, London, England, telephone Victoria* 5113. *The exhibition space of* THE FOUNDRY *is Stand No. 7, Row G.*

Refractories Companies Form Consolidation

Ashland Fire Brick Co., Ashland, Ky., operating three plants in that state, Crescent Refractories Co., Curwensville, Pa., operating three plants in Pennsylvania, Dover Fire Brick Co., Cleveland, having two plants at Strasburgh, O., Elk Fire Brick Co., St. Marys, Pa., with three plants in that state, Farber Fire Brick Co., Farber, Mo., and the Queens Run Refractories Co., having three plants in Pennsylvania, have consolidated to form the North American Refractories Co., with general offices in Cleveland. District sales offices are located at Boston, New York, Philadelphia, Pittsburgh, Chicago and Buffalo. The Canadian sales will be handled by the Canadian sales company, the North American Refractories, Ltd., Hamilton, Ont.

The new company will manufacture fire brick by the hand molding, hand pressing, steamed pressing and power pressing processes in all grades of Pennsylvania, Kentucky, Ohio and Missouri refractories. It also will make fire clay, high temperature cements and plastic fire brick.

The officers of the new company are: J. D. Ramsey, president; E. M.

Weinfurter, first vice president; H. E. Stuhler, vice president and treasurer; J. M. McKinley, vice president in charge of operations, John H. Cavender, vice president and sales manager; H. S. Sleicher, vice president and eastern sales manager; E. R. Cartrell, vice president in charge of the Ashland division and E. W. Valensi, secretary. North American Refractories Co. has purchased the assets, business and good will of the Pennsylvania Refractories Co., with a warehouse at 2877 East Thirty-seventh street, Cleveland, to be in a position to supply the needs of buyers who purchase less than car load lots in the Cleveland district.

McMyler Interests Sold

Industrial Brownhoist Corp., Cleveland, has purchased the McMyler Interstate Co., Bedford, O. The McMyler plant, machinery and materials are not included in the purchase but the manufacturing operations and business of the company, its drawings and records will be moved to the Cleveland plant of the Industrial Brownhoist Corp. Other plants of that company are located at Bay City, Mich., and Elyria, O.

Sells New Equipment

Royer Foundry & Machine Co., Wilkes-Barre, Pa., during the month of April sold sand separators and blenders to the following firms: City Pattern Works, Detroit; Corner Brook Foundry & Machine Co., Corner Brook, Newfoundland; Electric Alloys Co., Elyria, O.; Electric Auto-Lite Co., Fostoria, O.; Enterprise Iron Works, Inc., Albert Lea, Minn.; Goulds Pumps, Inc., Seneca Falls, N. Y.; Imperial Iron Corp., St. Catharines, Ont.; Independence Stove & Foundry Co., Independence, Mo.; Keeler Brass Co., Grand Rapids, Mich.; Meadows Mfg. Co., Bloomington, Ill.; Minster Machine Co., Minster, O.; Jas. Morrison Brass Mfg. Co. Ltd., Toronto, Ont.; and the Walworth Co., Boston.

Nominates Officers

At the April meeting of the Quad-City Foundrymen's association, the happenings at the Chicago convention were discussed and the officers for the ensuing year nominated. The nominations were as follows: F. W. Kirby, John Deere Spreader works, East Moline, Ill., president; R. L. Eichman, Bettendorf Co., Bettendorf, Iowa, vice president; J. P. Boaden, Union Malleable Iron Co., East Moline, Ill., secretary-treasurer. R. E. Kennedy, technical secretary of the American Foundrymen's association, was the guest of the association at the meeting. The May meeting will be addressed by H. V. Crawford, General Electric Co., Schenectady, N. Y., who will speak on a constant weight cupola blower.

Use Vane Type Rotor on Portable Grinder

Ingersoll-Rand Co., 11 Broadway. New York, has developed a new line of portable pneumatic grinders. The machines are light in weight and quiet in operation. They are equipped with speed governors which permit adjustment to any desired speed up to 6300 revolutions per minute. This feature permits grinding wheels of different diameters to be driven at the desired cutting speeds. The rotor has four power vanes and is made of hardened and ground steel. The rotor has a full-floating fit on its arbor which permits it to align itself between the two end plates without wearing pressure. The four power

Foundry Association Directory

American Foundrymen's Association

President, S. T. JOHNSTON, S. Obermayer Co., Chicago; secretary-treasurer, C. E. HOYT, 222 West Adams street, Chicago; technical secretary, R. E. KENNEDY, 222 West Adams street, Chicago.

Associated Brass Founders of New England

President, J. A. DUNCAN, Wm. Duncan & Sons Co., 166 Liverpool street, East Boston, Mass. Meeting the fourth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J McARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. HIRE, Hire Foundry Co., Peoria, Ill.; secretary, FRANKLIN WHITEHEAD, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, DAVID G. ANDERSON, Western Electric Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co. 2563 W. Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, 25 Woodrow street, West Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association

President RUSSELL M. SCOTT, Packard Motor Co., Detroit; secretary, WILLIAM J. MUHLITNER, Great Lakes Foundry Sand Co., Detroit. Meetings third Thursday in each month at appointed place.

East Bay Foundrymen's Association

Secretary O. R. MOLLER, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Gray Iron Institute

President, WALTER L. SEELBACH, Forest City-Walworth Run Foundries Co., Cleveland; Secretary, ARTHUR J. TUSCANY, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. FAUNTLEROY, Moline Malleable Iron Co., St. Charles, Ill.; secretary ROBERT E. BELT, Union Trust building, Cleveland.

Metrolpolitan Brass Founders' Association

President WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn N. Y.; secretary, WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue, New York.

Newark Foundrymen's Association

President, J. L. CARTER, Sachs-Barlow Foundries, Inc., Newark; secretary W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President CARL S. NEUMANN, Union Mfg. Co., New Britain, Conn.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio Foundries Association Inc.

President, C. C. SMITH, Toledo Steel Casting Co., Bancroft and Smead avenue, Toledo, O.; secretary-manager, E. F. SCOTT, 418 Penton building, Cleveland.

Philadelphia Foundrymen's Association

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary EARL SPARKS, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Southern Metal Trades Association

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Pittsburgh Foundrymen's Association

President, L. W. MESTA, Mesta Machine Co., Homestead, Pa.; secretary-treasurer WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association

President, F. W. KIRBY, John Deere Spreader Works, East Moline, Ill.; secretary-treasurer, J. P. BOADEN, Union Malleable Iron Co., East Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Steel Founders' Society of America

President, J. E. MCCAULEY, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; managing director, G. P. ROGERS, Graybar building, New York.

Tri-City Technical Council

Chairman F. V. SKELLEY, Tri-City Railway Co., Rock Island, Ill.; treasurer, MAX SKLOVSKY. Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

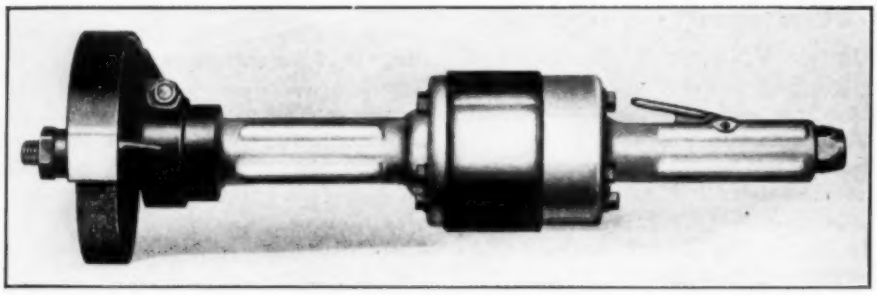
President, WILLIAM HOPPENJANZ, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, WILLIAM E. LOBERG, American Hoist & Derrick Co., St. Paul; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. W. ORPHAN, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.



THE GRINDER IS EQUIPPED WITH A VANE TYPE ROTOR AND A SPEED GOVERNOR

vanes balance the turning effort on the rotor giving a smooth flow of power.

An exhaust deflector is used which also serves as a muffler. The deflector may be turned in any desired direction. The wheel end bearing consists of two radial thrust ball bearings placed to take the thrust from either direction. This facilitates grinding on either side of the wheel.

An oil chamber is situated in the handle of the machine from which oil is fed into the live air going to the machine each time the grinder is stopped and started. That type grinder is adaptable to grinding, buffing, polishing or cleaning work. When fitted with wire brushes, it may be used as a cleaning machine for removing paint, scale, rust, etc., from metal surfaces. The machine may be obtained with two types of handles, a squeeze type straight handle or an inside trigger grip handle. The straight handle type is shown in the accompanying illustration.

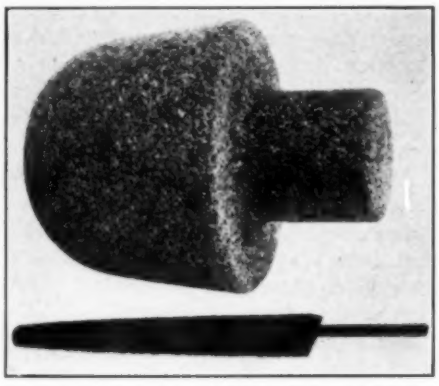
Contains High Silicon

Bethlehem Steel Co., Bethlehem, Pa., has published a booklet describing its new type natural chromium and nickel bearing pig iron. The pig iron has a carbon content of 2.50 per cent, silicon from 7.0 to 10.0 per cent; manganese, 2.0 to 2.50 per cent and phosphorus, 0.10 per cent. Chromium ranges from 0.80 to 1.25 per cent and nickel from 0.40 to 0.62 per cent. The booklet also gives information on the production of high quality cast iron with this new pig iron.

Makes Abrasive Files

Carborundum Co., Niagara Falls, N. Y., has introduced an abrasive file for removing and smoothing seam marks on dry sand cores. The files consist of steel rod around which is mounted the company's abrasive material bonded with an organic binder. They are fast and free cutting and because of that feature, considerable saving in file costs is claimed. The files are made in three standard overall lengths, 8½ inches, 10½ inches and 12 inches.

That company also has designed a ladle nozzle reamer, as shown in the



NEWLY DESIGNED LADLE NOZZLE REAMER AND AN ABRASIVE CORE FILE

illustration. These reamers are used to grind or ream clay nozzles to secure a good fit with the stopper head. The reamer is used with a brace and is rotated in the nozzle until the correct fit is obtained. The reamers are made of a coarse grit made by the company by the vitrified process and may be secured in practically any desired size or shape.

Develops Gas Furnace

American Gas Furnace Co., Elizabeth, N. J., with the aid of the American Gas association, 420 Lexington avenue, New York, has introduced a new type, gas fired, brass melting furnace. Many claims are made for the furnace such as low fuel consumption, small maintenance and labor costs, low metal losses, high output and quality castings.

The new furnace consists of a revolving, alloy metal retort, which is enclosed in a shell, lined with refractory material and heavily insulated. The retort is made from a special metal alloy which, it is said, will withstand working temperatures of over 2000 degrees Fahr. when repeatedly placed in contact with molten metal.

The insulated sheet steel shell is held in position by two bearings mounted on a steel frame in such a manner that the furnace may be tilted to any desired angle. Ten gas burners, five on each side, are mounted on the shell so that the flame throws its heat between the shell and the revolving retort. A motor, equipped with a variable chain and gear drive, rotates the retort.

Air for combustion is supplied under pressure to the gas lines serving the burners and the mixture may be regulated to produce a reducing atmosphere which prevents oxidation of the retort. A thermocouple projects into the combustion chamber and is connected to an automatic temperature control, recording pyrometer for controlling the temperature of the furnace.

The new furnace is equipped with an air tight cover which is bolted to the shell. A pipe is located at the center of the cover to allow the escape of gases from the furnace. After the gases are exhausted, which is a short time after the furnace is heated, an air tight cap screw is placed in the pipe thus making the furnace air tight.

A. Y. Gregory, formerly salesman of the Whitehead Bros. Co., Providence, R. I., in the New England district, has been appointed manager of sales in the New York district with headquarters in New York.

THE MELTING POT OF THE FURNACE IS TOTALLY ENCLOSED

Obituary

George Rowley Lombard, president of the Lombard Iron Works, Augusta, Ga., died recently at his home in Augusta at the age of 73 years. Mr. Lombard was born Jan. 1, 1856. He left school when he was 13 years of age to become office boy in his grandfather's plant, the forerunner of the present Lombard Iron Works. He learned the business quickly and assumed the responsibilities of an executive when he was extremely young. Beside his connection with the Lombard Iron Works, Mr. Lombard was a director of many manufacturing companies, had held public office and was well known in civic and fraternal circles.

William Harty, 82 years old, for many years president of the Canadian Locomotive Co., died recently at his home in Kingston, Ont. He was managing director of the Canadian Locomotive & Engine Co. from 1881 to 1900 when he bought the assets of the company which had gone into liquidation. He served as president of the reorganized corporation until 1912.

Charles E. Carpenter, for many years president of E. F. Houghton & Co., Philadelphia, manufacturers of oils and leathers for industrial purposes, died at Miami Beach, Fla., April 7, of heart disease. He was in his sixty-seventh year. Mr. Carpenter was active in politics and civic matters. He also wrote many editorials on social, economic and religious subjects for his company's organ "The Houghton Line."

Casper Reichl, for 16 years secretary and manager of the Spring City Foundry Co., Waukesha, Wis., died April 15, following an operation. Mr. Reichl was born April 24, 1869, at Milwaukee. He started his foundry career with the Milwaukee Bronze Casting Co., Milwaukee and was connected with the firm for 12 years. In 1911 he organized the Spring City Foundry Co., of which he was manager until he retired from business in 1927.

Victor H. Oxley, 57, general manager and treasurer of the E. R. Caldwell & Co., Bradford, Pa., foundry operators, died in the Buffalo General hospital, Buffalo, recently.

John H. Peters, foreman of the woodworking department of the Keck-Gonnerman Co., Mt. Vernon, Ind., died at his home in Mt. Vernon. He was 68 years of age.

Allen B. Van Eschen, foundry superintendent, Warman Steel Casting Co., Huntington Park, Calif., died recently. He was 48 years of age.

Harry Townsend, foundry superintendent of the Chain-Belt Co., Milwaukee, died April 10 at Chicago.

Newton A. Hemphill, 76 years old, at one time president of the Mackintosh-Hemphill Co., Pittsburgh, manufacturer of rolling mill machinery, died in Pittsburgh April 17. He retired from business in Pittsburgh in 1903 and later became identified with the oil business in Oklahoma.

Sullivan Machinery Co., Chicago, has removed its offices from the Peoples Gas building, 122 South Michigan avenue, to the seventh and eighth floors of the Wrigley building, 400 North Michigan avenue.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Philbrick, Booth & Spencer Inc., Hartford, Conn., is building a foundry addition.

Equipment of the Stewart-Walker Foundry Corp., Southington, Conn., was sold at auction April 23.

Electro Chemical Pattern & Mfg. Co., 3975 Beaufait avenue, Detroit, will erect a one-story addition, 30 x 70 feet.

Rome Stove & Range Co., Rome, Ga., has awarded the contract for a plant addition to Eagle Iron Works, Birmingham, Ala.

Fox Furnace Co., 206 Washington avenue, Elyria, O., M. Suppes, vice president, has awarded the entract for an addition to its plant and foundry. (Noted April 1.)

Washington Mould, Machine & Foundry Co., Washington, Pa., is having plans prepared for a foundry. Carlem Engineering Co., 6949 Lynn Way, Pittsburgh, is engineer.

Counterflo Heater Co., Salt Lake City, Utah, T. J. Yates, president, plans construction of a foundry. Contract for foundation has been awarded to Magdiel Bros.

Reliance Brass Foundry, Brooklyn, N. Y., has been incorporated with $25,000 preferred and 500 shares of common stock by D. R. Bernstein, 233 Broadway, New York.

Michel & Pfeffer Iron Works, Tenth and Harrison streets, San Francisco, is planning first unit of its plant to include bronze foundry, etc.

Bryant Pattern & Mfg. Works, 201 Glengary avenue, Windsor, Ont., has awarded a number of contracts for a machine and patternshop, which will cost about $60,000.

Blue Valley Foundry Co., 7019 Twelfth street, Kansas City, Mo., has filed plans for a one-story foundry, 50 x 70 feet. The building and equipment will cost about $18,000.

McManus Steel & Iron Co., Detroit, which recently took over the plant of the Buhl Malleable Co., has begun the manufacture of castings.

Elizabeth Steel Foundry, 5833 South Elizabeth street, Chicago, plans a 1-story addition, 52 x 124 feet, which will cost about $20,000. H. Christensen, 222 West Adams street, is the architect.

Plant and property of the Marine City Motor Casting Co., Marine City, Mich., has been acquired by new interests at a public sale. Plans are said to be under way for a reorganization of the company and a resumption of operations.

Auto Specialties Mfg. Co., St. Joseph, Mich., J. W. Tiscornia, vice president and general manager, is having plans drawn for foundry addition. F. E. Davidson, 53 West Jackson street, Chicago, is architect and engineer.

Central Iron Foundry Co., 1026 Dime Bank building, Detroit, has been incorporated with 1000 shares of no par value stock, by C. N. White, Grosse Point Shores, to deal in metal and foundry products.

Precision Castings Co., Syracuse, N. Y., which recently completed a plant at 12600 Beren road, Cleveland, will probably construct an addition soon according to J. R. Millspaugh, district representative.

H. H. Doehler, L. H. Pillion, F. J. Koegler, L. H. Morin, L. B. Kanter, C. O. Miniger, P. V. Schields, Jansen Noyes and H. A. Nehrbas have been elected directors of the Doehler Die Casting Co., New York.

Kohver Pattern Co., 1656 Second street, Milwaukee, has broken ground for a one-story addition, 50 x 104 feet. New machinery for the metal pattern department will be purchased.

White Plains Iron Works, Inc., White Plains, N. Y., has taken over property at North White Plains, N. Y., and soon will begin the production of ornamental cast and wrought iron.

Dodge Steel Corp., State road and Hellerman street, Philadelphia, has awarded the general contract to the Austin Co., Cleveland, for a one-story foundry addition. The building and equipment will cost about $30,000.

Cadillac Motor Car Co., 2860 Clark street, Detroit, has acquired the property adjoining its plant for construction of additions in connection with its recently announced expansion program. (Noted April 15.)

Koretke Brass & Mfg. Co., 922 Magazine street, New Orleans, will build a new one-story plant for its foundry and plating divisions. The building and equipment will cost nearly $25,000.

Searchlight Metals Mfg. Corp., 706 North Belmont avenue, Richmond, Va., recently incorporated, is constructing, two 2-story units, 40 x 130 feet, and has yet to purchase the following equipment, furnace brick, foundry flasks, burners, and brass furnaces.

Motor Pattern Foundry Co., 6105 Waterman avenue, Cleveland, has awarded a contract for the construction of a 1-story plant addi-

tion, 41 x 116 feet, to C. H. Webster 9507 Easton avenue, Cleveland. J. S. Parker is treasurer.

Crane Co., Chicago, has purchased a substantial interest in the Landon Radiator Corp., North Tonawanda, N. Y., and is arranging for increased production in that line. The Crane company will improve facilities at the plants at Chicago and Bridgeport, Conn.

Guelph Stove Co., Guelph, Ont., is having plans prepared for an addition to its foundry. The new addition will cost about $250,000 and work will begin immediately. This plant is operated by the T. Eaton Co., Ltd., 190 Yonge street, Toronto.

Commercial Iron Works, East Harrison and Union streets, Portland, Oreg., has awarded the general contract to George E. Mangas, Spaulding building for a one-story foundry unit. The building and equipment will cost about $24,000. (Noted Feb. 1.)

International Steel Corp., a Delaware company, has leased the plant of the former Canton Steel Foundry Co., Canton, O., and will probably start remodeling the plant at once, at a cost of about $400,000. The company will manufacture steel castings under a special process. S. W. Harley, Chicago, is president. (Noted May 1.)

Estate Stove Co., East avenue, Hamilton, O., has awarded the general contract to Benzing & Son, 709 South Ninth street, for a one-story machine and mechanical shop, 42 x 108 feet, and a one-story foundry addition 30 x 56 feet. The buildings and equipment will cost about $40,000. (Noted Feb. 1.)

American Steel Foundries, has reopened its plant at Verona, Pa., where the production of railway specialty castings has been resumed after a shut-down of more than a year. Some equipment will be purchased later and other improvements made, it is stated. (Noted March 15.)

Decatur Brass & Aluminum Foundry Co., Decatur, Ill., has moved to the plant of the former Halliday Co., Decatur, where it will install a new half-ton electric furnace and other equipment incident to its entry in the iron and semisteel castings fields, according to Fred Smith, president.

Damage to the plant of the Welland Steel Castings Co. Ltd., Welland, Ont., by fire was estimated at $15,000. Operations will be resumed shortly following temporary repairs. Machinery escaped with minor damages but two furnaces in the plant were water-logged and motors were badly damaged by water. The cause of the fire was not ascertained.

International Steel Corp., a Delaware company has leased the plant of the former Canton Street Foundry Co., Canton, O., and will probably start remodeling the plant at once, at a cost of about $400,000. The company will manufacture steel castings under a special process. S. W. Harley, Chicago, is president.

Consolidated Foundries Inc., San Francisco, is concluding negotiations for the purchase of the Best Steel Casting Co., which operates two plants at Oakland, Calif. Expansion of these facilities is planned. The Consolidated Foundries Inc. also operates the Jewell Steel & Malleable Co., San Francisco; Pacific Malleable Casting Co., Oakland, Calif.; and the Western Malleable Casting Co., Los Angeles.

The Aztec Stove & Foundry Works, 210 Corpus Christi street, Laredo, Tex., has begun the construction of a foundry building. The company will specialize in the manufacture of cast iron, wood burning stoves for export to Mexico and enameled gas stoves for the trade in the United States. Operations are expected to begin within the next 60 days. J. J. Gonzales is plant superintendent and manager and Alfonso Gonzales is foundry superintendent.

Foundations have been laid at Forty-third avenue and Thirty-eighth to Thirty-ninth streets, Long Island City, N. Y., for a new plant for the Allied Die-Casting Corp. Indications are that the new plant will be completed in September, at which time the company will move into the new quarters from its present plant which is located on Skillman avenue, Long Island City, N. Y. The new building will contain 75,000 square feet of floor space and plans call for making it one of the largest and best equipped die casting plants in the country. (Noted April 1.)

New Trade Publications

ROTARY PUMPS—Geo. D. Roper Corp., Rockford, Ill., recently issued a catalog on its rotary pumps. It contains illustrations, descriptions and data on the various types of pumps that that company manufactures. The catalog also contains many illustrations from photographs of typical installations, capacity and horsepower curves for the various types of pumps, instructions for locating trouble in pump installations, and a table which gives recommendations for the material used in the construction of pumps for various liquids such as acetic acid, ammonia, linseed oil, molasses, wood pulp, turpentine oil and many others. Much engineering data is included in the catalog.

NICKEL STEEL—The International Nickel Co., Inc., 67 Wall street, New York, recently has published a folder on the properties of nickel-chrome steel. The folder tells how the various tests were conducted, gives the data obtained and illustrates by means of charts the properties of the steel.

ALLOY CASTINGS—Alloy Cast Steel Co., Marion, O., has prepared a reference card of comparative casting material data, giving ultimate yield, elongation, reduction and brinell hardness.

WELDING—General Electric Co., Schenectady, N. Y., has published two bulletins on its arc-welders. The one describes two types of arc-welders. The first type is belt or motor driven, stationary or portable, self-excited, variable voltage, singly operated and has a current range of 100 to 500 amperes. The later type is belt, motor or gas-engine driven, stationary or portable, self-excited, variable voltage, singly operated with a current range of 60 to 300 amperes. In both bulletins distinctive features and specifications are discussed. The back of each bulletin illustrates many of the uses of arc-welding.

DESULPHURIZERS—The Mathieson Alkali Works, Inc., 250 Park avenue, New York, has issued its bulletin on the use of its desulphurizing compound in the manufacture of malleable iron.

PATTERN LETTERS AND FIGURES—H. W. Knight & Son, Seneca Falls, N. Y., in a current bulletin has described and illustrated its line of pattern letters and numbers. Price lists are given for the various sizes and illustrations show the various styles. The catalog also contains information concerning metal stamps, dowel pins and branding irons made by that company.

BEARINGS—The Timken Roller Bearing Co., Canton, O., recently published a fabricoid covered book containing information on the advantages, construction and uses of the bearings that it manufactures. The book contains 150 pages and is divided into eight sections. The following sections are included: I—Advantages of Timken Bearings; II—Timken Steel; III—Timken bearings in Automotive Equipment; IV—Timken Bearings in Railway Equipment; V—Timken Bearings in Industrial Machinery; VI—Timken Bearings in Household Appliances; VII—Timken Bearings in Farm Machinery; and the last section VIII—Technical Information. Each section is illustrated profusely with pictures of various articles using roller bearings. The use of these bearings is explained in each of the illustrations and their advantages shown with drawings. The latter part of the book is devoted to engineering data and aids in design where roller bearings can be used.

CONTROL FOR ACID BATHS—Leeds & Northrup Co., 4901 Stenton avenue, Philadelphia, recently has distributed a bulletin on the automatic control of acid baths. The apparatus described in the bulletin is designed to maintain a uniform strength of acid in a bath used in mercerizing processes. The apparatus furnishes a continuous record of the concentration of the bath, and holds the strength of a dilute acid within narrow limits. The bulletin also contains a layout and an illustration from a photograph of a typical installation. A price list of equipment for the installation of an acid bath control apparatus is included.

STEEL CASTINGS—Lebanon Steel Foundry, Lebanon, Pa., has issued a bulletin calling attention to the inconsequence of the cost of steel castings compared with the great cost of delays from failure of the castings. Dependability of its castings is stressed.

SAND HANDLING EQUIPMENT—Chain Belt Co., Milwaukee, Wis., recently issued a bulletin on its sand handling, conditioning and mold conveying system for the foundry. The bulletin lists the advantages of the sand systems, their adaptibility, and reductions in cost that justify the equipment. The various parts of complete sand handling and conditioning systems are discussed for various types of foundries as are conveying systems. The bulletin is illustrated extremely well with reproductions from photographs of many units. Layout sketches of several installations also are reproduced.

SAND AERATOR—William Sellers & Co., 1600 Hamilton street, Philadelphia, recently has circulated a folder describing and illustrating its sand aerator. The folder gives the advantages of the machine, its uses and prices.

TURPENTINE—General Naval Stores Co., Inc., North Side Bank building, Cincinnati, has issued a folder on the steam distilled wood turpentine which it sells. The folder contains the specifications followed by the manufacturers in the making of this product.

FOUNDRY EQUIPMENT — The American Foundry Equipment Co., Mishawaka, Ind., recently has published a bulletin on its foundry equipment. The booklet contains many views of installations, phantom views of several of their products and gives the advantages of each.

PATTERN EQUIPMENT — Electro-Chemical Pattern & Mfg. Co., 3975 Beaufait avenue, Detroit, recently circulated a folder describing the advantages of its copper patterns.

HIGH SPEED GRINDERS—Kling Bros. Engineering Works, 1300 North Kostner avenue, Chicago, has published a bulletin illustrating its new high speed double grinder. This unit is made in either the bench or floor type and uses either rubber bonded or bakelite wheels.

GASOLINE HOIST—A current folder by the American Hoist & Derrick Co., St. Paul, Minn., is devoted to a newly-designed hoist powered by a gasoline motor. Power is transmitted by a silent chain to what would be the crank shaft of a steam hoist. The folder also shows the company's two-speed drag scraperhoist. This serves as the power plant of a portable dragline installation.